JOURNAL

OF THE

FRANKLIN INSTITUTE

OF THE

State of Pennsylvania,

DEVOTED TO THE

MECHANIC ARTS, MANUFACTURES, GENERAL SCIENCE,

AND THE RECORDING OF

AMERICAN AND OTHER PATENTED INVENTIONS.

NOVEMBER, 1832.

On the arrangement of Safety Valves.

TO THE EDITOR OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Blairsville, Sept. 21, 1832.

Sir,—Should the arrangement for safety valves suggested below afford a probable remedy for *old* defects, without liability to produce greater *new* ones, please give the following remarks a place in your Journal, and oblige

Your obedient servant,

D. Livermore.

The experiments on the adhesion of disk valves, by Messrs. Hopkins and Roberts, as given in the last number of the Journal, seem to afford a probable solution of the causes of defective action sometimes observable in the safety valves of steam engines.

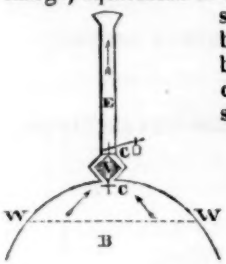
The reasoning of Mr. H. upon the subject, appears, however, more metaphysical than could be wished.

The experiments lead to the conclusion that adverse currents, or eddies, in the air discharged above the valve, contribute largely to produce the adhesive effects observed. The cause of these eddies may be traced to the enlargement of the discharging aperture immediately above the valve, giving room for sudden lateral expansion. This being likewise the case with safety valves of ordinary construction, we observe like defects in their operation.

It is, therefore, highly probable that valves so constructed as to give, when open, a uniform internal area for each cross section of the 'scape-pipe, would act with greater freedom and certainty. Suppose the valve conical both at top and bottom, or rather of such form

as to embrace two perfect cones connected at their bases, and the seat formed by an enlargement of the 'scape-pipe, so proportioned as to give the same capacity for discharge around the open valve as in other parts of the pipe. The lateral expansion above the valve would be sufficiently limited, and the lower formation such as to prevent counter currents from having a prejudicial effect by producing a vacuity under the valve, as observed in the experiments of Messrs. Hopkins and Roberts. To secure a vertical ascent and descent, pieces projecting from the vertices of the valve should pass through two cross bars. The upper bar serves likewise to limit the rise of the valve to the height required.

The enlargement of the 'scape-pipe should give room for the discharge, equivalent to the space occupied by the upper bar; but the same advantage can be obtained for the lower bar by placing it a little below the top of the boiler. The whole arrangement will be sufficiently obvious by reference to the annexed sketch.



E, 'scape-pipe.
V, valve (open.)
C, C, cross bars.
B, boiler.
W, W, water line.

FOR THE JOURNAL OF THE FRANKLIN INSTITUTE.

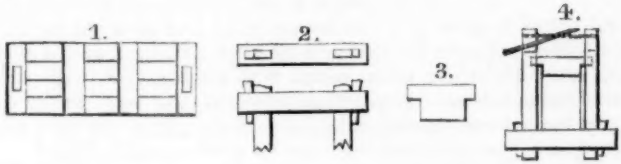
An abstract of the mode of Building in Pisé, or Earth Walls, with additional Suggestions, by J. D. Burr.

This method has been long practised with success, and very cheaply, in France and other parts of Europe. It is done by ramming moistened earth between planks or "mould boards," thus forming walls of cottages which, when dry, become firm, hard, and durable. Buildings are said to have been pulled down when nearly two centuries old, and that the walls were found still perfect.

In the first place, a preparatory brick, or stone, foundation must be built, to rise eighteen inches above the level of the ground, and of the thickness of the earth wall, which is usually eighteen inches at bottom, and reduced, or battered, to fifteen at top. This foundation is to preserve the wall from the effects of the splashing of rain.

The walls are formed by ramming earth of suitable quality (as hereafter described) between mould boards, which should be ten feet in length, and about two and a half feet wide, which are made like batton doors, and with four battons each from nine to twelve inches wide, two of them at the end, and two dividing equally the intermediate space; the boards should be of pine at least inch thick, strongly made, and tongued, and grooved, and planed smooth inside, and of equal thickness; on the end battons should be fixed strong cleats to serve

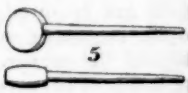
for handles, (fig. 1:) only two of these mould boards are required. They are placed on each side of the foundation wall, beginning at one corner, and the outside mould is projected beyond the corner, while one end of the other mould is made to fit the inside of the corner, thus to support the earth that is to be rammed between the moulds.* The moulds are to lap on the foundation wall at least one or two inches, and they are secured in that position at bottom by two pieces of scantling (for which recesses must be left, or cut, in the foundation,) dressed smooth and true, three feet long, five inches wide, and three thick, with mortises at each end to receive strong tenons of upright braces and wedges to secure them in their proper distances, (fig. 2;) four upright braces in their tenons extending a foot or more above the mould board, are secured at top by ropes passing around each two opposite braces which are drawn and secured to their proper position by twisting the rope with a stick in the same manner as a wood saw frame is braced. Two gauges, (fig. 3,) of the length to regulate the slope and thickness of the wall at the top of the mould, are there inserted between, or by the sides of, the braces, (fig. 4.)



The earth used for these walls must be a strong loam, of such properties that on being rammed hard when slightly moist, it will become firm when dry; this must be ascertained by experiment, i. e. by ramming the earth in any small box, or vessel, strong enough to resist the pressure, and letting it remain till dry, when it will be nearly as hard and solid as brick. Most stiff soils are considered good for this purpose; a light or sandy loam may be made suitable by mixing with it from one-eighth to one-fourth of clay. The earth should be well pulverized, and thrown up in ridges so that the lumps will roll down and be broken. The proper degree of moisture may be obtained by adding to any quantity of quite dry earth from one-half to one-eighth of its weight of water, in such manner as to thoroughly incorporate it.

To make the wall, only so much earth must be put between the moulds at once as will form a layer of three or four inches deep, which is to be rammed hard with a rammer of hard wood, the head of which is directed to be made circular, and swelling to the middle,

* It appears to me that it would be much better to have two pair of moulds, and to fit them up to each corner, embracing both sides in succession, which would form the corner more easily and completely, and more hands could in this manner be employed in ramming up. J. D. B.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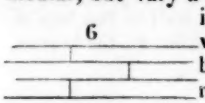
(fig. 5.*) and into this a suitable handle is inserted. The first strokes of the rammer should be made close to the side and then applied to every part of the surface. Several workmen may be employed in ramming one mould, each ramming his own division, and then crossing the stroke under the rope, so that the earth will be pressed in every direction: care must be taken that no fresh earth is received into the moulds until the first layer is thoroughly rammed, which is ascertained when the stroke of the rammer leaves hardly any print. Proceed in this manner till the mould is full, the braces are then slackened, the bottom piece drawn out, and the mould and frame removed to the next corner, when proceed as before. Observe, however, in placing the moulds, so to arrange or vary them, in opposite directions in each succeeding corner, that the joinings near the middle of each side of the wall shall not be perpendicular, but vary a foot or more in each layer, (fig. 6.) The joinings will not then be perceptible, and the wall will be rendered stronger. The holes left by the bottom pieces of the frame are to be filled up, and rammed when the wall is up.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Of the proper kinds of earth.—It is stated that, 1st, all earths in general are fit for use when they have not the lightness of poor land, nor the stiffness of clay. 2nd, all earths fit for vegetation. 3d, strong earths mixed with small gravel, with which the best work is done. Experience proves that so soon as the wall is made, the heaviest beams and rafters may be placed on them without danger. The gable end may also be made of earth wall.†

The door and window frames must be set in as the work progresses, they are made of one and a half or two inch plank, of a width to correspond with the thickness of the wall: the rebates and grooves for the doors, window sashes, and shutters, can be formed in the frames when made, or it may be done by mouldings after the walls are built. Strips of plank must be nailed all around on the outside of the frames to secure them firm in the wall. To bind the walls more strongly, at about every two feet of rise, strips of plank, split sticks, or laths, six or eight feet long, are laid lengthwise, but not nearer to the outside of the wall than two inches, that they may be hid; between these is a layer of the same material, eight or nine inches long, and laid across the wall for the same purposes. Walls built in this manner, of proper earth, are so substantial that the plates, rafters, and roofs, of the heaviest kind, may be immediately put on without danger.‡

* The form of the rammer is said to be very important; this I doubt. The weight, I believe, is not stated. I think the rammers used in iron foundries would answer perfectly well, viz. a flat iron head of about three pounds weight, to ram close to the moulds in the first place, and then a round iron head of about six pounds, to go over the whole.

† I apprehend it would be adviseable, until experience is gained, for them to be made with studs, and weather-boarded, in the usual way.

‡ Floors made by ramming earth in the same manner and raised about a foot

Remarks on the foregoing plan of Building Earth Walls for Cottages. By J. D. B.

Its adoption will be a great saving in rural economy where lumber and bricks are dear, or cannot be had; and would be preferable to log cabins in new settlements; such, however, is the force of habit that it will not supersede them; but I have made the above extracts with a view specially to the Liberian Colony, where the timber is not suitable for plank, and lumber for building is mostly imported, and is, of course, very expensive, and stone, or brick walls, equally or more so; and it is of great importance that new settlers, especially farmers, should be cheaply, readily, and comfortably accommodated. These benefits are all united in this plan. It is believed that half a dozen men would, after due preparations, ram up the walls of a cottage eighteen feet square, in two days; and as the natives are already versed in building huts of clay, the change will not be so great to them, but that they might be employed in this mode of building, and probably they would adopt it, as one of the earliest steps toward their civilization.

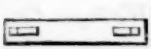
The only difficulty I apprehend in the execution of the work is, in so adjusting the moulds when drawn up, as to form and preserve the walls truly perpendicular, and with the intended *batter*, or taper. This will require as correct workmanship as in laying a brick wall. To obviate this difficulty, and put the business within the ability of common workmen, I will propose as a substitute for the moulding board a method that has occurred to me as simple and requiring very little skill, and which may, perhaps, be in other respects preferable—it is this:

The foundation being built, as above directed, of stone or brick, plant posts strongly in the ground on both sides of the foundation, three or four feet apart, in the direction of the walls, and higher than they are to rise. These posts must be in opposite pairs, stiff, and dressed straight on the inner sides, allowing as much space on each side of the foundation as merely to admit the plank, or board, used in the construction, by this mode, to be slipped, or driven, into the spaces. These boards may be of common inch, or inch and quarter, pine, but all used on any one side must be of equal thickness, and all with straight and fair edges and ends. They are to be placed inside of the posts, edge upon edge, as the wall is rammed up, one above another from bottom to top. The plank forming the interior must be cut of lengths to reach exactly from corner, on the outside their ends may project thus—

The posts are secured at top to allow just the space for the thickness of the wall, and of the planks on each side, by tenons made on the posts, over which braces, or gauges, with

above the level, will doubtless be dry, comfortable, and as healthy as brick pavement.

When the walls have become dry, which will require several months, they may be whitewashed with lime, or rough-cast in the usual way, and will then appear as handsome as any stuccoed wall.


mortices, are placed and secured by wedges on the outer sides. When the wall is made, the wedges being driven out, the gauges, planks, and posts, may be successively removed, and the wall is completed. The only difficulty I anticipate in this process, will be in planting the posts exactly in true lines. This, however, I think may be effected by first planting the posts nearest to each corner in correct positions; then fixing the braces on them at top and dropping upon them thick plank of such width as to fill up the space between the posts, which plank will then regulate the tops of all the posts that remain to be set up.

For a single building this plan might be more expensive than the first described, but where a number of houses are to be built, as the same posts and boards will answer for all of them, I believe it would be cheapest, easiest, and certainly best, where good mechanics are wanting.

In putting on the roof it will be prudent to give the eaves a bold projection, to secure the walls from the effects of rain, and also to put a weather, or wash, board in a sloping position, across the ends of the house (from eve to eve,) for the same purpose.

Nothing yet has been said in regard to chimnies. I presume when brick work is easily procured, it may be best to build the chimney therewith when the foundation is laid; but in Liberia, if wanted at all, the fire-place may be built of brick or stone, and the chimney be formed of clay like the native huts, and outside of the wall; similar to the plan pursued with log houses in this country.

FRANKLIN INSTITUTE.

Continuation of the Report of the Committee of the Franklin Institute of Pennsylvania, appointed May, 1829, to ascertain, by experiment, the value of Water as a Moving Power.

(Continued from p. 16.)

WHEEL No. IV.

This wheel, six feet in diameter, was substituted for No. III. The barreling of the shaft was removed, and the chain, which supported the weights raised, wound directly upon the axis. The iron basket, used in former experiments to contain the weights, was also removed, and the weights were applied directly, by hooks, to the chain.

To ascertain the amount of friction at the gudgeons of the wheel, a cord was wound around the axle, and weights applied until a uniform velocity, of six feet per second, was maintained in the periphery of the wheel, by the descent of the weights. The weight of the wheel was twelve hundred pounds, and seventeen and four-tenths pounds maintained a velocity of six feet per second. The friction was therefore nearly one and a half per cent, (1.45) of the weight. One per cent of the weight applied was, as before, the ratio of friction upon the gudgeons of the drum.

The rate of friction being different in the wheel and drum, the calculations relating to it are less conveniently made than in the former cases. The principle upon which they are made is, however, still simple and obvious. When any weight is applied to the chain and raised by the wheel, the gudgeons of the drum support the tension of both the parts of the chain, viz. that between the drum and the weight, and that between the drum and the wheel; the pressure upon the axis of the drum is therefore twice the weight raised. The rate of friction upon this is one per cent.

The tension of the part of the chain between the drum and wheel, the chain being very nearly vertical, relieves the gudgeons of the wheel of a weight equivalent to that tension; that is, to the weight applied to the other end of the chain. The friction upon this weight, at one and a half per cent., is therefore to be deducted from the friction due to the weight of the wheel.

The following calculations are made in accordance with the principles just stated.

Constant *inactive* weight.		
Weight of the wheel, - -	1200 lbs.	
Friction given by experiment, -		17.40 lbs.
Average weight of the chain wound around the axle of the water wheel, - -	80 ,,	
Friction at one and a half per cent., -		1.20 ,,
Weight of the drum, -	200 ,,	
Friction at one per cent. - -		2.00 ,,
Weight of the chain borne by the gudgeons of the drum, - - -	184 ,,	
Friction at one per cent., - -		1.84 ,,
Friction due to constant *inactive* weight, -		22.44 lbs.
Constant *resisting* weight.		
Weight of the chain between the shaft and the ground, - - -	20 lbs.	
One piece of lead, - -	9 ,,	
Sum, - - -	29 lbs.	
Pressure upon the gudgeons of the drum due to 29 lbs., - -	58 lbs.	
Friction at one per cent., -	.58 lb.	
Gudgeons of the wheel relieved from,	29 ,,	
Friction at one and a half per cent., -	.43 ,,	
Difference, - - -	.15 lb.	
Friction, carried out, - - -		.15 lb.

The centre of gravity of the wheel when loaded was 1.75 feet from the axis, the chain was .5 ft. from the same axis; hence to raise 29 lbs. and overcome a friction of (22.44 +

.15) 22.59 lbs. required a weight of water of 14.74 lbs. The friction upon this at one and a half per cent. is - - - - .22 lb.

Total friction when a weight of 29 lbs. was raised, - - - - 22.81 lbs.

To determine the friction due to a weight added, as, for example, to 56 lbs. we have—

Pressure upon gudgeons of drum,	- 112 lbs.	
Friction at one per cent.,	- -	1.12 lb.
Gudgeons of wheel relieved from	- 56 ,,	
Friction at one and a half per cent.	-	.84 ,,
Difference,	- - - -	.28 lb.

To balance 56 lbs. and overcome a friction of .28 lb. required, of water, 16.08 lbs. The friction upon this at one and a half per cent. is - - - - .24 lb.

Total friction for 56 lbs. additional weight, .52 lb.

The details in relation to wheel No. IV, are as follow:

The diameter of the wheel six feet; the breadth twenty inches, or sixteen inches between the cants; cants six inches deep.

Advantage was taken of the very manageable size of this wheel to experiment upon various forms of buckets. The varieties are figured on Plate VIII, figures 1, 2, 3, 4, 5. Fig. 1 shows the form and dimensions of the first variety of elbow buckets: in these the width of the elbow was three inches, and the opening at the throat two inches; the number of buckets twenty. Fig. 2 represents the second variety of elbow buckets; the width of elbow, as before, three inches, and opening of the throat two inches, the number of buckets forty. Fig. 3 gives the form of the oblique buckets next affixed to the wheel; the face of each bucket made an angle of thirty degrees with the tangent to the wheel at the point at which the bucket was placed; they differ, therefore, from the oblique buckets which were used with wheel No. I. There were thirty of these buckets around the wheel. Figs. 4 and 5 show the two forms of curved buckets which were made the subjects of experiment. The lines upon which the curved buckets of fig. 4 were traced (see *a b* fig. 4, Plate VIII.) made angles of twelve degrees with the tangents at the several points at which the buckets were placed, thus representing very oblique buckets; on these lines the buckets were traced by the following method, which is given for a single bucket. The width of throat being fixed at two inches, a circular arc was traced through *a*, tangent to a circle of two inches and a half radius, and described with the centre *b*; thus the proper width of throat, allowing for the thickness of the boards forming the buckets, was secured; to this circular arc a line *d e*, being drawn tangent, completed the form of the bucket.

After the buckets just described had been made the subjects of ex-

periment, the straight line part was cut away until the throat was widened to three and one-eighth inches, giving the bucket shown in fig. 5. In this case a more easy escape was provided for the air, and, of course, a more free accession permitted to the water.

It was not deemed necessary to add to the already prolonged labours of the committee, by repeating the excellent experiments of Poncelet on the application of curved buckets to undershot wheels.

This wheel was used only as an overshot wheel; the breast, when used, extended to the level of the centre of the wheel. The gate generally used in the experiments with this wheel is shown in fig. 1 of Plate VIII, in which *a* is the chute, and *b* the sliding gate, which in the figure is closed; by drawing this gate to the right, the chute was opened, and the water delivered between the projection *c* and the side *d* of the chute.

To ascertain the relative effect of water when issuing under a head upon the wheel, and when taken from the surface, by being allowed to flow over a gate, the form of gate given in fig. 6, Plate VIII. was used. An opening, *a b*, was made in the bottom of the forebay, to one side of which the hinged gate *c* was attached, the hinge being at *a;* the gate was moved by the stem *d*. When the face was vertical, as shown by the full lines in the figure, the gate prevented the water from passing to the wheel; when inclined, as shown by the dotted lines, the water, which was kept at a constant level in the forebay, flowed over the surface of the gate and fell upon the wheel. In using this gate the direction of the motion of the wheel was reversed, and there was no breast.

The experiments made with wheel No. IV. will be given in five tables. Table 1, parts I and II, will contain the results of trial with the forty elbow buckets (fig. 2, plate VIII;) table 2, parts I, II and III, those with the twenty elbow buckets, (fig. 1, Plate VIII;) table 3, parts I, II and III, those with the thirty oblique buckets, (fig. 3, Plate VIII;) and table 4, those with the curved buckets of fig. 4 Plate VIII; and table 5, those with the curved buckets of fig. 5, of the same plate. The experiments with the gate of fig. 6, Plate VIII, were made with the curved buckets of fig. 5, and are included in the table 5 with those made with the same buckets and the gate of fig. 1.

The tables now to be given complete those containing the record of the experimental researches of the committee in relation to water wheels. Circumstances prevented the committee from taking up the subject of the reaction wheel, to which they alluded in the commencement of this report.

Table 1.—Part I.

Wheel No. IV. 40 Elbow buckets. Close breast. Water let on at upper centre of wheel.

No. of Expt's.	Head of water above. Bttm. of gate.	Top of bkt.	Bttm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Seds	Feet.	Pds.	Feet.						
1	0.25	0.50	1.00	0.50	29	22.81	51.81	40.0	36½	5.94	550	6.50	22750	20724	.911	.911	5.94	
2					43	22.94	65.94		49	4.43	470		30550	26376	.863			
3					57	23.07	80.07		55	3.93	585		38025	32028	.842			
4					71	23.20	94.20		73	2.97	720		46800	37680	.805			
5				1.00	43	22.94	65.94		29½	7.35	500		32500	26376	.812			
6					57	23.07	80.07		35	6.20	600		39000	32028	.821			
7					71	23.20	94.20		41	5.29	680		44200	37680	.852	.852	5.29	
8					85	23.33	108.33		48½	4.47	815		52975	43332	.818			
9					99	23.46	122.46		57	3.80	930		60450	48984	.810			
10				1.25	57	23.07	80.07		30½	7.11	630		40950	32028	.782			
11					71	23.20	94.20		36½	5.94	720		46800	37680	.805			
12					85	23.33	108.33		41½	5.22	800		52000	43332	.833	.833	5.22	
13					99	23.46	122.46		47	4.61	920		59800	48984	.819			
14					113	23.59	136.59		49	4.43	1035		67275	54636	.812			
15					127	23.72	150.72		59	3.67	1145		74425	60288	.810			
16				1.50	85	23.33	108.33		34½	6.29	835		54275	43332	.798	.798	6.29	
17					99	23.46	122.46		39½	5.49	950		61750	48984	.793			
18					113	23.59	136.59		46½	4.67	1080		70200	54636	.778			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Table 1.—Part II.

Wheel No. IV.—40 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above. Btm. of gate.	Head of water above. Top of bkt	Head of water above. Btm. of bkt.	Width of aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt.of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
19	0.25	0.50	1.00	1.75	85	23.33	108.33	40.0	31½	7.11	955	6.50	62075	43332	.698			
20					99	23.46	122.46		38½	5.64	1075		69875	48984	.701			
21					113	23.59	136.59		39½	5.49	1150		74750	54636	.731	.731	5.49	
22					127	23.72	150.72		46	4.71	1280		83200	60288	.724			
23					146	23.90	169.90		51½	4.23	1355		88075	60288	.684			
24	0.75	1.00	1.50	0.38	85	23.33	108.33	40.0	34½	6.29	795	7.00	55650	43332	.779			
25					99	23.46	122.46		43	5.03	880		61600	48984	.795	.795	5.03	
26					113	23.59	136.59		45½	4.75	995		69650	54636	.784			
27				0.75	113	23.59	136.59		39	5.57	975		68250	54636	.801	.801	5.57	
28					127	23.72	150.72		45½	4.75	1085		75950	60288	.794			
29					138	23.83	161.83		51	4.29	1175		82250	64728	.787			
30				1.00	138	23.83	161.83		35	6.20	1255		87850	64728	.737			
31					146	23.90	169.90		36	6.03	1320		92400	67960	.735			
32					160	24.03	184.03		38½	5.64	1400		98000	73612	.751			
33					174	24.16	198.16		40½	5.35	1600		105000	79264	.755	.755	5.35	
34				1.25	174	24.16	198.16		41½	5.22	1525		106750	79264	.743			
35					184	24.25	208.25		39½	5.49	1590		111300	83300	.748	.748	5.49	
36					198	24.39	222.39		40½	5.35	1705		119350	88956	.746			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 2.—PART I.

WHEEL No. IV.—20 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above. Btm. of gate.	Top of bkt.	Btm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pds.	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
1	0.25	0.50	1.00	0.50	30	22.82	52.82	40.0	37	5.86	375	6.50	24375	21128	.867	.867	5.86	
2					41	22.92	63.92		49	4.43	465		30225	25568	.846			
3					44	22.95	66.95		49	4.43	490		31850	26780	.841			
4					58	23.08	81.08		62	3.50	605		39325	32432	.825			
5				0.75	44	22.95	66.95		37½	5.78	500		32500	26780	.824	.824	5.78	
6					58	23.08	81.08		46½	4.67	615		39975	32432	.811			
7					72	23.21	95.21		57	3.80	730		47450	38084	.803			
8				1.00	44	22.95	66.95		33	6.57	555		36075	26780	.742			
9					58	23.08	81.08		38	5.71	665		43225	32432	.750	.750	5.71	
10					72	23.21	95.21		46	4.71	805		52325	38084	.728			
11					86	23.34	109.34		59½	3.64	950		61750	43736	.708			
12				1.50	58	23.08	81.08		30½	7.11	740		48100	32432	.674			
13					72	23.21	95.21		33	6.57	800		52000	38084	.732			
14					86	23.34	109.34		38	5.71	910		59150	43736	.739	.739	5.71	
15					100	23.47	123.47		44	4.90	1040		67600	49388	.731			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

TABLE 2.—PART II.

WHEEL No. IV.—20 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Experiment.	Head of Water above. Bttm. of gate.	Top of bkt.	Bttm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raisd.	Height raised.	Time.	Velocity per second.	Wt of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet.	In.	Pds.	Pounds	Pounds.	Feet.	Scds.	Feet.	Pds.	Feet.						
16	0.75	1.00	1.50	0.38	44	22.95	66.95	40.0	31½	6.89	470	7.00	32900	26780	.814			
17					58	23.08	81.08		36½	5.94	550		38500	32432	.842	.842	5.94	
18					72	23.21	95.21		43½	4.96	675		47250	38084	.806			
19				0.50	58	23.08	81.08		32½	6.67	585		40950	32432	.792			
20					72	23.21	95.21		37	5.86	680		47600	38084	.800	.800	5.86	
21					86	23.34	109.34		43½	4.96	800		56000	43736	.781			
22					100	23.47	123.47		54	4.00	925		64750	49388	.763			
23					114	23.60	137.60		58	3.74	1045		73150	55040	.752			
24					133	23.78	156.78		55	3.93	1245		87150	62712	.720			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

Table 2.—Part III.

Wheel No. IV.—20 *Elbow buckets. Close breast. Water let on at upper centre of wheel.*

No. of Exper't.	Head of water above. Bttm. of gate.	Top of bkt.	Bttm. of bkt.	Width of Aperture.	Weight raised.	Friction.	Sum of friction and weight raised.	Height raised.	Time.	Velocity per second.	W of water expended.	Head and fall.	Power.	Effect.	Ratio, power being 1.	Maximum effect.	Velocity at maximum.	Observations.
	Feet.	Feet.	Feet	In.	Pds.	Pounds	Pounds.	Feet.	Seds.	Feet.	Pds.	Feet.						
25	2.75	3.00	3.50	0.17	58	23.08	81.08	40.0	25½	8.51	645	9.00	58050	32432	.559			
26					72	23.21	95.21		27	8.03	665		59850	38084	.636			
27					86	23.34	109.34		30½	7.11	730		65700	43736	.665	.665	7.11	
28					100	23.47	123.47		35	6.20	825		74250	49388	.665			
29					114	23.60	137.60		37	5.86	930		83700	55040	.657			
30					128	23.78	151.73		37½	5.78	1045		94050	60692	.645			
31				0.25	58	23.08	81.08		22	9.86	925		83250	32432	.390			
32					86	23.34	109.34		24	9.04	1005		90450	43736	.484			
33					114	23.60	137.60		26	8.34	1105		99450	55040	.553			
34					161	24.04	185.04		30½	7.11	1335		120150	74016	.616			
35					189	24.30	213.30		35	6.20	1520		136800	85320	.624	.624	6.20	
36					217	24.56	241.56		38½	5.64	1730		155700	96624	.620			
37					231	24.69	255.69		42½	5.09	1830		164700	102276	.620			
38	3.75	4.00	4.50	0.12	58	23.08	81.08	40.0	25½	8.51	600	10.00	60000	32432	.540			
39					72	23.21	95.21		30	7.23	630		63000	38084	.604	.604	7.23	
40					100	23.47	123.47		40	5.42	845		84500	49388	.584			
41					114	23.60	137.60		42	5.16	960		96000	55040	.573			
42					133	23.78	156.78		45½	4.75	1100		110000	627120	.570			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	

[TO BE CONTINUED.]

Analysis of the Report, &c. on Steam Carriages.

Report on Steam Carriages by a Committee of the House of Commons of Great Britain. With the minutes of Evidence, and Appendix. Reprinted by order of the House of Representatives of the United States. (1832.)

(Continued from p. 273.)

"You have stated that you think the bringing of these machines to perfection is retarded, because there is not a sufficient prospect of encouragement, and that steam coaches are therefore confined to the hands of persons who have not the same skill in practical mechanics as others, who would undertake the subject if adequate encouragement were offered; can you point out any mode by which that encouragement could be given? Nothing could do it so effectually as offering a handsome parliamentary reward for the attainment of some specified performance, such as keeping a steam coach for passengers regularly plying on some suitable road for two years, during which it should not have failed to arrive by steam more than some specified number of times, and within a certain number of hours of lost time from the time-bill of the mail on the same road. Suppose this were done between London and Bristol, for a reward of £10,000, it would cost the public nothing if it were not accomplished, and the establishment of that one coach to carry the mail would be worth the money to the public whenever it was accomplished: or between London and Holyhead would be still more important, but that would require £20,000 reward. Another plan of more immediate application would be to offer a bounty of a fair price per mile for carrying despatches by steam (as I suggested before) whenever they arrive in a specified time; the price should be sufficient to pay expenses. That would, I think, be the best course, because I believe it would be undertaken at once by individuals, provided that no stipulations were made either for or against carrying passengers or goods. They would be sure to carry passengers and goods as soon as they could, for their own profit; and it might be stipulated, that after any coach had earned a certain sum in bounty, it should not be entitled to more. The effect of such public rewards has been very striking in the case of the invention of means of ascertaining the longitude at sea. Another way would be, instead of money, to give exclusive privileges for a term to any persons who should first succeed in establishing steam coaches on specified roads, under specified conditions of performance; or a society offering a premium, as was done in the case of steam navigation to India, would have a good effect: as was also shown in the case of the locomotive steam carriages on the rail-way between Liverpool and Manchester. There a most inadequate premium (only £500,) brought the invention forward more than ten following years of desultory and unencouraged attempts would have done."

"You think those means would produce a great effect? I have no doubt of it; an important result may often be within a moderate sum of attainment, and yet a prudent man will not set about it. It will be certain to cost £1,000 and a year's hard labour of an engineer, whose time is worth £500 more, to make a new steam carriage in a proper manner and bring it to bear as a business, supposing that its performance turns out as near to previous calculation, according to the experimental coaches now in existence, as can be expected, and that no radical alterations require to be afterwards made in it. After succeeding in the attempt, he must expect to make copies of it on the same terms as other makers, who would examine one of the first coaches he sends out, and copy it with very little trouble. The operations of competent mechanicians in making first machines of new invention, and bringing them to perfection in all their details, are necessarily more expensive than those of first inventors, who execute their experimental machines in a slovenly manner with cheap workmanship only as

experiments; but when those experiments have been gone through, an extreme soundness and accuracy of workmanship is the only chance of attaining success in the machines which are sent out for real business. For want of experience to direct the mechanician as to the right form, dimensions, and weight, of each piece of his machine, it often happens that, after having made a piece of expensive work, it will prove too slight or too heavy when set to work, and he may have to make it over again as expensively. The copyists who will afterwards come into competition with him when his machine is brought to bear, will have no such difficulties."

"You conceive that a grant of public money as a premium would call forth the necessary degree of skill? I have no doubt of it; we have had very few instances of invention being stimulated by the offer of public reward; but the instances, ascertaining the longitude is a most brilliant example. The facility and accuracy with which the longitude is now determined at sea, is the result of one of the greatest efforts of human genius and perseverance. The stimulus of reward has occasioned both modes of it to be perfected, viz. by astronomical observations and by time-keepers. We should very soon have steam carriages brought into full use if such a reward were offered."

"Have you ever ascertained the duty or performance of work done in respect to the fuel consumed by locomotive engines? They vary so greatly, that it is difficult to make a statement. The common locomotive engines which have been used for several years to draw coal wagons on rail-ways, have remained without material improvement for a long time, and their performance is very low, being only equal to raising about four millions pounds weight one foot high by the consumption of a bushel of coals, their boilers evaporating about four cubic feet and a half of water into steam with each bushel of coals. Such engines exert six to eight horse power. Mr. Stephenson's new quick-going engines on the Liverpool and Manchester rail-way are more improved in duty, and are in a progressive course of improvement; but as they burn coke instead of coal, the established mode of computation is inapplicable. Mr. Stephenson's small engine, called the Rocket, which gained the prize of £500, offered by the Liverpool and Manchester rail-way company, and which was the model for succeeding engines, exerted about six horse power during that trial, and burned 177 lbs. of coke per hour, which is at the rate of about five millions and a half pounds weight, raised one foot high by the consumption of eighty-four pounds of coal; but they have greatly reduced the consumption of fuel in the succeeding engines on that rail-way, owing to enclosing the cylinders of the engines within the lower part of the chimney, were they kept very hot, and an increased effect has been given to the fire by blowing the waste steam upwards through the chimney, as I stated before. In the Rocket they were just beginning to be aware of the value of that expedient for animating the fire, and it was done in a degree, but it has been since done more completely."

"Do you know how near any part of the rail-road between Manchester and Liverpool runs to the common road?—I cannot say; in passing along the rail-way, I do not recollect seeing the turnpike road, except crossing it several times."

"The noise made by the engines used on the rail-way is much greater than by the steam coaches, is it not? Yes; Mr. Hancock's coach makes less noise than any of Mr. Stephenson's engines; but the power exerted by the latter is much greater than by Mr. Hancock's engines. The quick travelling carriages on the Manchester and Liverpool rail-way, when drawn by the last improved engines, are extremely easy in their motion."

"Is it your opinion that a road would suffer less injury from the fore and hind wheels of a steam carriage following each other, in the same tracks on the road, than if they run on different tracks? That depends upon what kind of action the wheels exert on the road; if they cut it up and disturb the materials, by pressing down some stones so deep as to displace other stones sideways, and

cause them to rise up at the sides of the track, then it is best not to allow such wheels to cut the road twice in the same places; but if the fore wheels roll the road smooth on the surface, and consolidate, without disturbing, the materials; that is, if they only press down the stones over which they pass as much as will produce a close contact, but not so much as to displace the neighbouring stones laterally, then I think the hinder wheels should follow in the tracks of the fore wheels; certainly that is best for the carriage; and I believe it will be found that it makes but little difference to a good hard road whether the four wheels of a carriage follow in the same track or not, provided that the wheels are not loaded so as to indent deeply into the solid materials of the road. All carriages ought to have their wheels of such a breadth that they will not leave any material indentations in the road. They should rather consolidate the materials than break them up. If the fore wheels are only so much loaded, in proportion to their breadth and to the hardness of the road materials, that they will consolidate the materials over which they have passed, then I think it is quite as well for the road, and much easier for the carriage, that the hind wheels should follow in the tracks of the fore wheels. The loading of the carriage may be so arranged that the principal weight will be borne on the hind wheels, and the fore wheels may (by a suitable apportionment of breadth) be qualified to consolidate the road in their tracks, and thus prepare the way for the passage of the hind wheels, with the least wear of the road and the greatest ease to the carriage. It is quite as much the interest of the proprietors of carriages, as of the road trusts, that the roads should not be cut up by too narrow wheels, for it is always at the expense of horse labour that the road is thus injured, independently of the evil of having a worse road to travel over the next time. If the wheels are too narrow for the load upon them, and the road materials soft, so that the wheels do print tracks in the road, that evil will be greater, if the hind wheels follow the fore wheels than if they run in new paths; but it is better to remove the evil, by using broader wheels or less load, or harder road materials, and to run the wheels in the same tracks; because the resistance to a carriage is, in all cases, increased by running the wheels in different tracks, and that with little or no benefit to the road; particularly when the road is covered with mud and wet dirt, or snow. The above observations apply to all four wheeled carriages, whether they are drawn by horses or impelled by steam; but, in common carriages, the horses' feet tend to dig up the road. I think the steam carriages will, when perfected, be free from that objection, and that they have a greater claim to be allowed to run their wheels in the same tracks than other carriages.

"Were you ever in Mr. Hancock's carriage when travelling? Yes; I have ridden on it; but he has put in larger cylinders since I went with him the last time, and I understand makes better progress now. I have examined all his present machinery in detail, and think it very judiciously planned."

"Did you find that it frightened horses, or annoyed passengers? I have stated before, that I found horses were not frightened; but every one must judge for himself of the degree of annoyance he experiences. Persons who are accustomed to travel in luxurious private carriages, would find many annoyances in a common stage coach, which others would consider as excellent travelling. I am so accustomed to machinery, and to stage coach travelling, and to steamboats, that I am not liable to be annoyed thereby; and I found riding in Mr. Hancock's carriage to be exceedingly like travelling in a stage coach. I heard no complaints by passengers. I believe he has never found any difficulty in getting passengers, since he has run for hire. Persons are reported to be annoyed by the smell of hot grease, in the steam coaches on the Cheltenham road; I can only say, that I never observed such a smell in Mr. Hancock's carriage. If there are any real annoyances to the passengers in particular steam coaches, they will work their own cure in a short time, either by the proprietors finding out remedies, or else giving up their coaches, as they must do if they are not rendered agreeable to the passengers. The only question that

deserves attention is, whether there is any danger to passengers, or any serious annoyance to other persons not passengers."

"Did you observe any horses or carriages passing his carriage? Yes, I have always passed through crowds of horses and carriages with all the steam coaches I have tried; there is so much curiosity excited by the novelty of a steam coach in motion, that all the horses on the road are drawn up to get a sight of it, and many are turned to follow after it. I have observed that some horses take very little notice of the steam coach; others are a little startled, but I never saw any difficulty which the reins could not control with the greatest ease. Horses are easily alarmed at any thing unusual, but they very soon become accustomed to any thing, as is shown by the readiness with which horses can be brought to endure discharges of fire arms and of artillery. A patent was taken out some years ago for what was called a travelling Advertiser; it was a small four wheeled carriage, supporting an enormous octagonal tower, which was stuck all over the outside with printed bills for advertisements. It was drawn very slowly through the streets by one horse, and had a most unusual appearance: this machine was indicted as a nuisance because it frightened horses."

"Have you never observed horses to shy at a stage coach when heavily laden? I have observed horses to be alarmed at the enormous bulk which some of the vans carry at times at a great height above the ground. Horses are the most timid animals to encounter every thing that they are not accustomed to, and the most courageous animals to encounter every thing that they are accustomed to, even when really terrific, such as discharges of fire arms."

"Had you occasion to turn any sharp corners when in Mr. Hancock's carriage? Yes, many; the yard of his premises is exceedingly narrow and inconvenient to turn into and out from, but it is done with ease by the steam coach; the same place would not do at all for a coach and four horses to put up at."

"Going at what speed can you turn round a sharp corner without any danger? I do not remember turning with any considerable speed, nor should it ever be attempted with any carriage if it can be avoided, and there can be no necessity or pretence for going quick when turning a steam coach, as its power is quite controllable, in which respect it has a great advantage over a common carriage; for four horses at the moment of turning, are very little under the control of the reins, particularly the leaders, and it depends upon their good will whether they choose to go slow or go quick when turning. In a steam carriage, the conductor has such a perfect control of the power, that he can never fail in checking the speed at the moment of turning. I observed that Mr. Hancock's carriage is steered with the greatest ease, and will turn round in a very short space: I have seen him turn round in the new road to return without backing the carriage at all, although he was in the middle of the road when he began to turn."

"If you had turned a sharp corner, could you have stopped immediately on meeting a carriage? Yes; the power of stoppage is most remarkable: that is one of the great advantages of a steam coach. I have steered Mr. Hancock's carriage myself, and found it to be most completely under control."

"The carriage may be turned in the smallest space that the wheels will permit it to go round in? Yes, in a much smaller space than a carriage with horses can turn, because it is so much shorter in the total length, and the power being completely under control, there is no danger in turning quite short; whereas no prudent driver will turn a four horse coach round in a road, without the guard getting down and holding the leaders' heads; for they are not sufficiently under the control of the reins in turning to do it with safety."

"Did you ever see a steam carriage going down a hill? Yes, down the hill of the new road at Islington; and it was done with more safety than with any carriage with four horses; but I do not contemplate the descent of steam coaches down very steep hills, for that supposes their getting up such hills, which is not likely to be accomplished soon, and the present coaches seem to me to be only

fit for our most improved lines of roads, where all very steep hills have been reduced to moderate slopes.

"Have you turned your attention particularly to the subject of going up steep hills, and what ascent do you think can be surmounted? In forming my opinion of the probability that steam carriages will be brought to bear, I could not overlook the circumstance that they would have to go up and down hills; but most of our great lines of roads are now so improved, that what were formerly called steep hills are not very numerous or frequent; but wherever they do occur, I propose to give the steam coach the assistance of a pair of post horses in aid of its own power. In going down hill, steam coaches are very safe, because the whole power can be effectually exerted to retard or resist the turning of the wheels."

"Mr. Gurney's steam coach has gone up Highgate hill without horses? Yes, but I understood that it was broken in pieces in coming down again. My objection to attempting to make a steam coach go up a steep hill, in the present state of our knowledge, is, that it requires to have a great strength, and consequent weight of machinery to have a sufficient power to do so with safety, and which weight is a useless incumbrance and impediment to progression at all other times. The question is, whether all the machinery of a steam carriage should be made twice as strong and heavy as is necessary for impelling it with safety on a tolerably level road, merely that it may have power within itself for going up a few occasional hills, or whether it is better to make the machinery lighter, and take the occasional assistance of a pair of post horses? There can be no objection to the latter expedient, except the expense of such horses; and as the steam coach can carry goods to profit in place of all the weight of machinery which is saved by making it lighter, I think that the aid of post horses would be an economy. In forming such an opinion, I have followed a maxim which I had always found to hold true; viz. that steam power is certain to be more profitable than horses, if the work is to be kept constantly going on, because then the great advantage of steam power, that it does not tire, becomes fully available; and to perform the same service by horses, a very great number must be kept for change; but for business which requires only occasional working, or for working during only as many hours each day as horses can do without changing, steam power loses its great advantage over horses, and in some cases they will do the work cheaper. One great item of the expense of steam power is the first cost of machinery and engineers' wages; both which would be only the same for working twelve hours per day, as for one hour and a half, which is the utmost that a stage coach horse can draw at ten miles an hour. A steam coach should work twelve or fourteen hours in every twenty-four hours, to gain the full advantage of the system of steam power over horse labour; the intervening ten or twelve hours will allow ample time for putting every thing in perfect order for the next journey, if the machinery is what it ought to be, and there should be a spare coach for every two which are running, to allow time for more considerable repairs: hence, I reckon that three steam coaches should keep up a double passage of 100 or 120 miles a day continually. Expensive machinery, which is only to be worked occasionally, will not, in some cases, do work so cheap as it can be done by men or by horses without machinery; and that I conceive to be the case with the extra cost, weight, strength, and complication, which must be given to the machinery of a steam coach, in order to enable it to go safely up steep hills without assistance. I apply these remarks to the present steam coaches, but future improvements may in time produce that species of machinery which will effect the going up hill with less difficulty than the present. It has been supposed that the diameters of the cylinders being larger than is necessary for going on level ground, they could be worked with a diminished strength of steam to go on level ground, and stronger steam when going up hill. To get up ordinary and moderate hills, that is certainly the right plan; but it requires the strength of all the moving parts of the engines to be made sufficient to bear the utmost force that the

pistons can exert when impelled by the strongest steam that is ever to be used; also, the large wheels which run upon the road should be made very broad on the edges, and of proportionate strength. The present coaches have been faulty in these respects, and yet the machinery is too heavy. Another way of getting sufficient power to go up hill is to have the pistons only a suitable size for going along the ordinary road, and to introduce wheel work, which can be thrown into action when a hill is to be ascended, and which will turn the wheels of the carriage round only once for three turns of the cranks of the engine, and consequently with a triple force. Mr. Hancock has shown me the parts of such machinery which he is now making for a new steam coach, with wheel work and endless chains, on a plan which I think very likely to answer for ascending moderate hills; but for very steep hills, I think it is desirable to have the help of post horses. The immediate desideratum is, to construct a steam coach with the power and strength necessary to go quickly and safely along the best lines of road which can be found, without any steep hills upon them, taking the assistance of post horses where it is necessary. If that is accomplished, and such a coach is worked continually for two or three years, it would probably lead to the knowledge of the proper kind of machinery to go up steeper hills; but if the adoption of steam coaches is to wait until they are rendered much more perfect, it will be a very long time, because practice is essential to finding out a proper plan."

"Do you think there is any danger in going down a hill in a steam carriage? Much less than in a common stage coach, for by backing the engines, so that their power is brought to act in opposition to the turning round of the wheels, and with the assistance of drags, or brakes, to rub on the rims of the wheels, and aid in retarding their motion by friction, steam coaches will safely go down all moderate hills, such as are met with on our best lines of turnpike roads, say between London and Holyhead; and with machinery such as Mr. Hancock is now making, if it is suitably proportioned, I expect a steam coach would not require assistance to get up a hill at more than five or six places between London and Holyhead."

The information given in relation to ascending and descending hills, having a local reference, we give only the general results.

A hill of the slope of one in eighteen, (about 3° 10′,) Mr. Farey considers too steep to be ascended by locomotives in their present state, without risk of fracture, unless assisted by horses, the road not being supposed of the best sort. They could ascend a hill of one in thirty, (about 2°,) without assistance.

We return to the printed evidence of Mr. Farey.

"Have you turned your attention to the subject of apportioning the tolls on steam carriages, so that they may bear their due proportion to the tolls on carriages drawn by horses? No, I have not paid much attention thereto; it is a subject which would require more consideration and more data than I have before me. I am convinced that if a steam coach, complete when travelling, weighs no more on an average than a stage coach with its four horses complete weighs on an average, there is no reason for charging any extra toll for steam coaches, but, on the contrary, I believe it will turn out in the sequel that they ought to go for less toll, because they will wear the roads less than the present coaches whenever they are made really efficient; and, in the mean time, until that is accomplished, I think it may be very safely left to the chance of events as to injuring the roads to any extent whatever, by injudicious attempts to work steam coaches of an injurious construction; from the consideration that if any new coach which may be started, does injure the road, it will be very soon given up from its own demerits, probably before it has produced any visible effect on the road. Suppose its wheels were to slip so much as to plough out ruts on

the road, it would most probably stick fast, or be broken to pieces in the first journey along the road, and such abortive attempts will not be repeated very frequently. It is idle to talk of one or two steam carriages doing much visible injury to a frequented road in a year or two, even if they run constantly, for suppose that each one wears the road four or five times as much as one carriage of the same weight drawn by horses (including those horses in the weight,) it would only be equivalent to four or five additional coaches passing each day, and that on the road from London to Birmingham, for instance, would be quite imperceptible. I am confident that any steam coach which does a road any greater damage than is equivalent to that done by carriages drawn by horses, will fail of itself in a short time, and prove an unsuccessful project. I should strongly recommend the new system to be left to its own chance of success or failure, as far as the roads and the safety of passengers are concerned; and I think the same reasoning applies against any regulation for the breadth of the wheels for steam carriages, because they will not perform well if their wheels are so narrow as to cut the road materially. I understand that the old system of regulations and penalties, as to over weights on given breadths of wheels for common carriages, has been done away with on the roads in an extensive district round London, and I think it is good policy, from the circumstance that the proportion regulates itself by the interest of the owners of carriages, when the fact is understood that carriage wheels, which are too narrow in proportion to the load on them, and to the hardness and goodness of the road, will always draw more heavily than wheels of a suitable breadth; and that, though the carriers may not find out the proper breadth at once, they will do so in the end. The old acts for forcing the use of very broad wheels by making tolls operate as penalties and premiums, was a most injudicious system of legislation, and did nothing but harm; the carriers soon found out how to evade the intention of the act, by using very broad conical or barrelled wheels, rounding on the edges, which conformed to the words of the law, but which acted on the road like narrow wheels. The broad wheels intended to have been encouraged by the old act of parliament, were expected to act as rollers to make and improve the roads, and were encouraged to carry excessive loads for that object; but if the wheels of the broad wheeled wagons not actually used had been really such as the legislature contemplated, they could have been continued in use on account of the great increase of draught; but the broad wheels actually used, carried such loads, that they crushed the road materials to powder, owing to the conical form of the wheels and the bending of the axletrees; they bore on the road almost wholly at the inner edges of the iron tires, and not across all their breadth, as was intended. The advantage to the carriers in tolls, and in increased loads, induced them to use such broad-wheels, when it would have been against their interest to have done so, if they had paid the same tolls for the weight of goods as other carriers, and their operation on the road was more injurious than that of any other carriages. There is no particular breadth of wheels which can be prescribed as the best to carry given loads over all sorts of roads, for much depends upon the hardness of the road materials, the size to which the pieces are broken, their general form and disposition to consolidate into a hard bed, the resistance the materials offer to wet and frost, and to wearing by the wheels; the breadth of the wheels, and the load upon them, should be adapted to all the combinations of circumstances, and the carrier will soon find, if his wheels are not best adapted to the road, by the draught being greater than it ought to be. As to steam coaches, the wear which will take place on roads, from all that can, by any probability, be expected to be brought into use for some years, will be so small that it cannot be felt for a considerable period, and when it is felt, it will be time to look round and see what is the real effect on the roads of those particular coaches which are in use, and apportion the tolls that they ought to pay."

"Is it your opinion that weight for weight, including the weight of horses on one hand, and of engines, and an average of the water and fuel on the other, the tolls should be the same on steam carriages as on horse-drawn carriages? I

think that if it were so it would prove a considerable advantage to the roads, because as I have stated before, I think the roads will be considerably benefitted by the change of impelling by steam instead of by horses. I think it will be a great public benefit when steam coaches come into common use, and hence that it is expedient that a moderate bounty should be offered for the adoption of steam carriages, by giving them all possible advantage they can have without trenching on the interests of individuals; and if they were allowed to run toll free, and duty free, until a certain number were in use, or during a certain time, it would much accelerate their introduction, because it would diminish the loss that must necessarily be incurred by running them before they are perfected in their construction. Small encouragements or discouragements have a considerable effect on new inventions in their infant and imperfect state. The advantage to the public from steam navigation is now generally acknowledged, but when steam-boats were in their infancy, an attempt was made by the watermen on the Thames to suppress them, by contending that, according to their charter, and the usage of the city of London, no persons could be allowed to own a vessel plying for passengers on the Thames, nor to work on board of such a vessel, except they were freemen of the city, and belonging to the watermen's chest. This would have effectually prevented any engine men being employed, and, in addition, the watermen engaged all their members to refuse to navigate them. After a long dispute and delay of the steam boats, it was decided that one out of a number of owners being free was sufficient, and that the men employed to manage the engines were not subject to the watermen's regulations of freedom of the river; some watermen were induced, by giving them small shares in lieu of wages, to exercise their right of freedom in favour of the real owners, and to navigate the vessel. It was afterwards attempted to get the measurement and calculation for the registered tonnage of the steam vessels made according to the extreme breadth across the projecting boxes which contain paddle wheels, under the pretext that they occupied that width in the river and in harbours, instead of measuring the breadth of the vessel at the surface of the water. If that could have been enforced, it would have nearly doubled all the rates on steam vessels, compared with other vessels; but the subject being brought before parliament, an act was passed to give them the advantage of deducting as much from the length of the vessel as is occupied by engines and machinery in calculating the registered tonnage. This was, in effect, a small bounty upon steam vessels, for they have no claim to such an advantage over sailing vessels; when the weight of masts, sails, and rigging, in the latter, is not deducted in calculating their tonnage. The effect of that measure has been favourable to the advancement of steam navigation, for though it was but a very trifling bounty, and is now of no consequence, it came as a well-timed aid, at the date when that act passed, because almost all steam vessels were then navigated at a loss, they were so imperfect (like steam coaches at the present day,) that their engines were continually getting out of order, whereby they failed to make their passages, and required expensive repairs; their consumption of fuel was great, and the wear of boiler excessive. On the other hand, few passengers would go in them at first, and some terrible accidents which happened in a few vessels, caused them all to be avoided by passengers for a long time. It was only by persisting in keeping them going as well as they could, and thereby gaining experience in their management, that the numerous defects of their construction were remedied. Most of the earliest steam-boats had two or three successive editions of engines and machinery before they were rendered so perfect as to become profitable; and, in addition to the expenses of such alterations and improvements in the machinery, they were obliged to make their passages regularly for some time after they were rendered tolerably effective before they acquired sufficient confidence with the public as to their safety and punctuality, to enable them to obtain as many passengers as would pay the expenses of navigating the vessels. For all these reasons any increase of their expenses was severely felt at that losing period; many

were abandoned, and the difference in the expenses occasioned by the rates to which vessels are liable, being calculated according to the breadth across the paddle wheels, or according to the act passed for measuring them short by all the space taken up by the engines, would have occasioned others which have been brought to bear to have been given up, before they had attained so much perfection as to enable them to earn their expenses. In the same manner the tolls levied upon steam coaches at present are to be regarded, not as payments out of the profits of a gainful trade, but as an increase of loss upon that which is yet, and which must inevitably continue to be for some time, a losing business. The ultimate success to which I look forward is entirely dependent on the circumstance of the first speculators in steam coaches being enabled to go through a sufficient term of inefficient performance, and consequent loss, to acquire experience in the new business; and that experience will, no doubt, lead to expensive alterations and re-constructions of their machinery. There is so much mechanical talent to be had for money, that I have no doubt of the final accomplishment, if the attempts now making are continued long enough; because I am confident that there is (as was the case in steam-boats) a real efficacy in the principle of action. The general opinion of engineers was not very favourable to steam-boats, when they were first brought forward as a novelty; many doubted if they could ever be made to perform well, particularly at sea; and others, who foresaw the possibility of that, doubted whether they would answer in point of expense of fuel; and wear and tear of engines and boilers. If no assistance or encouragement is given to inventions when they are in the infant state which steam coaches are now in, persons who find that they only lose money when they expected to gain, by being the first to adopt the improvements, are liable to become disheartened, and give up the pursuit too precipitately, whereby their undertaking dies a natural death; and that is sometimes the case when it might have been established by another two or three weeks' continuance of the efforts; and that continuance might be induced by some small relief, like the reduction which was made by parliament in the register tonnage of steam vessels, or the taking off of the tolls from the earliest steam coaches. If by any means they are enabled to go on till the proper plan of machinery and management is found out, they will afterwards keep their ground, because the profit of working by steam in lieu of horses will be very great. The present steam coaches are mere experiments, and the next editions of each plan of them will, I expect, be losing concerns, and will continue so to be for some time. Under those circumstances, every small increase of their expenses is a real retardation to that practical establishment of the invention which will render it useful to the public; such retardation by small causes is operative to a greater extent than can easily be conceived. Steam coaches will very well bear all tolls and taxes to which other coaches are subject, when they are able to carry passengers regularly and profitably; but they want encouragement now, instead of difficulties being thrown in their way. As to the right of tolls on turnpike roads, it should be recollected that turnpike roads are not property, like canals, but trusts, to be exercised for the benefit of the public; and if it is for the interest of the public that steam coaches should be brought into use, and if that bringing into use will be accelerated by suspending the tolls on them at first, the trustees of roads ought not to object to such an arrangement. The real amount of tolls they will forego, will be an exceedingly small per centage on the income of their tolls; for so long as steam coaches are losing concerns, they cannot be very numerous."

"In the course of your examination, have you meant to confine your evidence to steam coaches? Yes, to steam coaches for public conveyance of passengers and parcels, in the manner of stage coaches, and travelling at the rate of ten miles an hour on our best lines of turnpike roads, with occasional assistance of one or two post horses, where necessary, to surmount unusual hills, or very bad pieces of new laid road. If it were thought admissible to begin with travelling at a less speed than that, and to carry goods only in the manner of vans, the

thing is nearer to accomplishment, because the accommodation and comfort of passengers would then be out of the question, and also the violence to which quick travelling carriages are subjected, requires a greater strength of all the parts than would be necessary to carry the same weight at a lower speed. In other respects steam power will propel a carriage as cheaply at a quick rate as at a slow rate. That fact is proved on rail-ways, in actual business; and steam coaches will be the same whenever they can be made strong enough to bear quick motion without being overloaded with weight of machinery. That will be one of their great advantages over horse labour, which becomes more and more expensive as the speed is increased. There is every reason to expect, that, in the end, the rate of travelling by steam will be much quicker than the utmost speed of travelling by horses; in short, that safety to travellers will become the limit to speed, as is now the case on rail-ways."

"What is your opinion as to impelling wagons by steam? I have never considered that at all in detail, and am not prepared to give evidence upon the subject. The price of carrying passengers or goods at a quick speed, as is done by stage coaches, or vans, will always be so much higher than the prices of carrying an equal weight at a slow speed, as is done by wagons, that I see no inducement to attempt steam wagons, which I think would present almost all the difficulties of steam vans. According to theory, the cost of carriage by steam will, as I have stated, be proportionate to weight and distance, without regard to speed of motion; for instance, to convey a coach loaded with two tons for a distance of ten miles only, the same fuel will be consumed, and the same wear of machinery will be occasioned, whether that distance is run in one hour or in four hours. The wages of engineers, conductor, and guard, will be only one-fourth with the quick speed, and the first outlay in machinery would be only one-fourth, because four times as many engines must be on the road, with their attendants, at the same time, to do the work at a slow speed, as at a quick speed; but the money earned by the carrier at the slow speed, will be only a small part of what would be earned at the quick speed."

"Taking into consideration the comparative expense of horse carriages and steam carriages, do you suppose that steam carriages will be able to run for half the charges of horse carriages? My own idea is, that steam coaches will, very soon after their first establishment, be run for one-third of the cost of the present stage coaches; but to become a business at all, it must necessarily be a business which will offer strong inducements to persons to embark in it, and to do that, the rate of profit must be very much greater than that which is commonly expected to be realized by the proprietors of stage coaches. Their present trade affords a less profit on the capital and trouble of management probably than any other sort of business which is carried on with spirit in this country. The great reason of that is, the constant loss by destruction of horses, the fluctuations of the price and quality of horse-keep, and the impossibility of reducing stage coach establishments in times when travelling business is flat; because the horses must be kept, and men to attend them, at all events, and the loss of running a coach half employed is not so great as suspending it, and keeping the horses idle on short allowance till better times come round. The profit of stage coaches which load well is very high, particularly in the fine travelling season, and that occasional profit creates an excitement which induces the injudicious to set up more coaches than are wanted for an average of all seasons; and for the reasons above stated, their expenses when once set going, cannot be reduced to meet bad times. The adoption of steam coaches will set the trade free from its great commercial difficulty, because they can be laid up and kept idle without considerable loss, and brought out again when wanted without any new outlay; also, fuel does not fluctuate either in price or quality to any considerable extent, like horse corn. In short, the capital embarked in a steam coach trade will not be so rapidly wasted as at present in horses. Owing to the great number of horses which must be first bought and then kept to do the same work as one steam coach, the first outlay in stock will be very small

in steam coaches, compared with horses, the same of stables, hostlers, and harness. The daily expenses of fuel and attendants will be very much less than that of horse keep and attendance; the wear and tear of the coaches, and all that is coachmaker's work, will be only the same as at present, but the wear and tear of engines and machinery, though a very expensive item on each engine, will be nothing to compare with the present repairs, loss, and decay of horses, because the number of engines is so small. Stage coach horses require to be all renewed every three years, notwithstanding a heavy annual expense for what may be called repairs of horses: viz. harness, shoeing, and farriery. Engines with an equally heavy annual expense of repairs to that of horses, will, when perfected, be kept up thereby in such a state as to last for many years without renewal. The metal parts of machinery only wear at particular places, which are capable of being repaired or renewed, so that they become as good as new; but a horse, when worn to disease at any part, feet, eyes, or lungs, becomes incapable of stage coach work forever afterwards."

"Do you apply the principle you have stated respecting the probable wear of the roads by steam power being less than by horses, to heavy wagons? Yes: my proposition that the wear of the roads will always be at the expense of the carrier, applies to all carriages whatever, but more particularly to those impelled by steam than to those drawn by horses, because carriages drawn by horses may be so mismanaged, as to do very great injury to the roads, and yet may make good progress in travelling. For instance, a wagon having very narrow wheels, carrying a heavy overload, having a sufficient team of strong heavy horses, may be drawn along although it breaks the road up to any extent, and that as much by the feet of the horses as by the narrow wheels; but, if it were attempted to impel the same wagon by steam power acting by the adhesion of the wheels to the road, they would slip round, and it would not get along the road. I am confident that carriages to be impelled by steam machinery turning the wheels, cannot be made to answer any good purpose, either for conveyance of travellers, or goods, so long as they materially injure the roads, because if the wheels slip materially on the road, or if they cut sensible ruts in the road, they will not advance the carriage efficiently. On the other hand, horses may be made to draw a carriage which will injure the road. I think that principle must apply to steam wagons as well as to steam coaches."

"The heavier the loads to be drawn, the more important it is to apply steam instead of horses, if the roads will be benefitted by that substitution? I think so, as far as the roads are concerned, but I doubt if steam wagons will offer any comparison of the profit to be derived from steam coaches. To get along the road, steam wagons will require very broad wheels, and there is no danger of doing injury to the road by them, for they will not get along if the wheels are too narrow, but narrow wheeled wagons drawn by horses may do an injury to any extent, for extra horses may be put on, and they will injure the road with their feet, at the same time that they draw a carriage after them which also injures the road. It will be a loss to the carrier to do so, but there is nothing in the nature of the operation to prevent it being done, as there would be in the case of steam wagons."

"Of course, a steam carriage going slower than ten miles an hour will be more expensive to travel, on account of the greater expenditure of fuel? No; the consumption of fuel, according to time, would be as much less as the motion would be slower; so that the consumption of fuel, according to distance, would be the same, whether for a quick speed or for a slow speed; but when profit is considered, every thing is in favour of quick speed; because all goods carried slow must be carried cheap; and quick conveyance will bear the highest price of carriage, on account of the expense of going quick by horses. For instance, a ton of goods may be carried a mile by steam power with a certain consumption of fuel, but it should take no more fuel to carry it a mile, at the rate of two and a half miles an hour, than at ten miles an hour. There is some qualification to be made in that statement according to the state of the roads; it will be true

if they are hard and good, but if they are heavy, the expense of fuel will be a little more for the quick speed than for the slower speed; and it is also to be understood, that the engines must be suitably proportioned for attaining quick speeds, because engines, which are only adapted for slow motion, do not work to so great an advantage when they are urged to work quick as when they are worked at or below the speed which the proportions of their parts are adapted to move with; nevertheless, that extra expense of going quick by steam power will be but small, and nothing like the increased cost of travelling quick with horses; for horses have only a limited speed at which they can travel, if they have no load to carry or drag after them, the whole of their muscular strength being then required to advance the weight of their own bodies. The speed with which stage coaches now travel, approaches so near to the speed with which the horse could travel without any load, that their force of draught becomes very small. In all cases, horses lose force of draught in a much greater proportion than they gain speed, and hence the work they do becomes more expensive as they go quicker. The quickest stage coach travelling is now at the rate of eleven miles an hour, and that appears to be very near to the utmost limits which nature has prescribed for animal exertion; for those horses require renewal of the whole stock every two or three years. This is the comparison of steam power and horse labour, during the time that each is actually in operation; but the real difference between the performance of a steam engine and that of a set of horses will be found to be very great, when it is considered, that, by having one spare steam coach for every two or three which are on the road, those coaches can travel continually all the year round, during fourteen or fifteen hours in every twenty-four hours, without any intermission, except stopping for one or two minutes to take in water at every stage of about seven or eight miles; and thus each steam coach can travel 140 or 150 miles a day, whereas a set of four stage coach horses can only work during seven hours and a half out of every twenty-four hours, or each horse can run fifteen miles a day, and that exertion wears them out very soon. A cart horse, travelling at the rate of two miles and a half an hour, can work during eight hours out of every twenty-four hours, or he can travel twenty miles in a day. Suppose that in both cases, of horses going ten miles an hour, or only two miles and a half an hour, the force of traction was the same during the time that they were actually drawing; even on that supposition, there would be the difference between twenty miles a day and fifteen miles a day in favour of slow travelling; but in considering the work performed, the great loss in the force of draught by quick travelling must be taken into account; and it will be found that a cart horse walking at two miles and a half an hour, could draw with a force of traction 100 lbs. on an average, but that a stage coach horse, running at ten miles an hour, cannot exert more than 28 lbs. force of traction at an average. The above proportion of distance travelled, and force of traction exerted in each case being combined into one product, the portion will stand thus: 20 miles a day $\times$ 100 lbs. draught $=$ 20,000, to represent the work done by a horse travelling at the rate of two miles and a half an hour, and fifteen miles a day $\times$ 28 lbs. draught $=$ 420 to represent the work done by a horse travelling at the rate of ten miles an hour, which is four and three-fourths to one in favour of a slow speed; when with steam power there would be only a very slight difference of performance at the quick or the slow speed."

"Respecting the injury done to the roads by heavy carriages, whether they are drawn by horses or impelled by steam power, you consider that weight for weight (including horses and engines as part of the weight) the one will not do more injury to the road than the other? In my opinion, the steam carriages will do the least injury of the two. The horses, by treading with their feet, excavate and scrape out depressions in the surface of the road; that is particularly the case before the road materials are consolidated into a solid mass; and the evil of depressions or holes in the road is not the mere injury done by the feet of the horses to those particular parts of the road in which the depressions

are made, but the wheels of other carriages which pass over such depressions, drop heavily with force into them, so as to make the depressions continually deeper and larger, and to loosen the surrounding stones. In this manner the horses, after injuring the road themselves, prepare the way for further injury to the road by the wheels of carriages. To have the full benefit of the rolling action of the wheels in consolidating the road materials, the latter must be laid smooth and level before the wheels come upon them; but if the materials are previously thrown up into little hills and holes, the wheels will do mischief instead of good."

"Suppose the engine and machinery in a steam carriage to weigh two tons, and to be able to advance an additional load, equal to their own weight, along a good road, at an average speed of ten miles an hour, do you think that any additional toll should be imposed upon steam carriages beyond that paid by four horse stage coaches, or vans; assuming the four horses to weigh two tons, and to draw a load of two tons, at the rate of ten miles an hour? In such a case, I can see no reason whatever for any increase of toll; but the diminished wear of the roads, which I anticipate from the use of steam in lieu of horses, will be a reason for a reduction of tolls whenever such a diminution of wear is realized."

"Would horses drawing eighty cwt. upon a road, with a slow walking pace, in your opinion, do more injury to the road than an engine doing the same work? I have had no experience of drawing heavy weights by steam to enable me to form an opinion respecting the effect that the broad wheels, which must then be used, would have on the road, and what advancing power they would have before they began to slip on the road, without advancing the carriage forwards; nor what would be the weight of engines which could advance eighty cwt. at a slow speed. I feel some doubt of the practicability of making steam engines advance so many times their own weight, as I expect this would be, with effect, and I feel confident that, in the present state of the art, there would be no profit in doing it; but if it were accomplished, I believe that the broad wheels of the steam wagon would do no injury to the road, whereas, in heavy wagons, drawn slowly by horses, the horses do much more injury by digging and scraping with their feet than is done by the horse in coaches and vans travelling quickly; because the wagon horses having a heavy pull to make must choose places in the road where they can place their feet in depressions, in order to get hold; hence, on a good smooth road they slip and scrape up the surface."

[TO BE CONTINUED.]

Tract on Comets, and particularly on the Comet that is to intersect the earth's path in October, 1832. *By M. Arago. Translated from the French, by John Farrar, Boston*, 1832.

We avail ourselves of the privilege afforded by our title page, in which our devotion to general science is expressed, to give a notice with extracts from an essay on *comets* lately set forth by the French philosopher Arago. This tract comes to us in an English dress through the translation of Professor Farrar, of Cambridge, Massachusetts: it was, in the original, an essay in the almanack for 1832, published by the French Board of Longitude.* It would be thankless in us, after having the labour of translation done for us, to find fault with the manner of its execution; besides, we know experimentally

* Mémorial du Bureau des Longitudes, 1832.

the difficulty of avoiding gallicisms in a translation from the French; we may, notwithstanding, venture the remark that the French astronomer would have appeared better, before the American public, if a few of his national peculiarities had been softened down to suit the more frigid temperament of his new readers.

The comet which was the "exciting cause" of this essay by M. Arago, is one which unassisted eyes are promised a sight of in the months of October and November of this year; not, as a widely spread two-penny tract would have us believe, growing in size until it rivals the full moon in shining, and with a tail overspreading half the heavens, but with even more modest pretensions to notice than when it last visited us in 1826. The humble little publication to which I have just referred, after exciting our consternation by the description of a mighty monster, gravely tells that it cannot hurt, and that as harmless as the bright moon itself it will decrease as it had increased, and disappear from our astonished sight.

The veritable account which M. Arago gives of this comet is as follows.

Comet of Six Years and Three Quarters.

"We have now come in our account of comets to another periodical one, which is to reappear, like that just described, in 1832, and whose near approach, we are told, will be attended with fatal consequences to the earth and its inhabitants.

"This comet was discovered at Johannisburg on the 27th of February, 1826, by M. Biela, and ten days afterwards at Marseilles, by M. Gambart. The latter calculated the parabolic elements without delay, by means of his own observations, and immediately perceived, on consulting the table of the elements of comets, that this was not its first appearance, but that it had been already observed in 1805 and in 1772.

"The comet of 1826 is therefore periodical.

"It was accordingly necessary to change the parabolic elements into elliptical elements, in order to discover the length of the comet's orbit left undetermined by the former. Messrs. Clausen and Gambart undertook this calculation, and each found, at nearly the same time, that the new comet made a revolution round the sun in about seven years.

"This curious result was adopted without dispute; for, in 1826, astronomers were cured of their old notion that the revolution of a comet must *necessarily* be very long; while, from the example of the comet of 1770, it was deemed imprudent to venture to determine the time of the future reappearance of a new comet, before all the derangements and perturbations to which it was liable in its whole course, had been thoroughly studied. My colleague, M. Damoiseau, undertook this long and minute calculation, the result of which is as follows.

"The comet of six years and three quarters will cross the plane

of the ecliptic, that is, the plane in which the earth moves on the 29th of October, 1832, before midnight.

"The earth, during its annual course round the sun, never leaves the plane of the ecliptic; therefore it is only somewhere in this plane that a comet could strike it; of course, if we had any thing to fear from the comet of 1832, the danger would be on the 29th of October, before midnight.

"Now let us inquire whether the point, at which the comet will cross the plane of the ecliptic, is near the path that the earth describes; for, in order that there may be a meeting between the two bodies, this is as necessary a condition as the other.

"Upon this point it is proved, by calculation, that the passage of the comet through the plane of the ecliptic *will be a little within our orbit, and at a distance from it equal to two and a third of the earth's diameters, or* 18,500 *miles.* It is possible that this distance, already so small, may disappear entirely, if we suppose certain small variations in the elements, given by Damoiseau, which it is difficult to answer for.

"Let us, however, take two diameters and a third, as the real distance; we must remember that this has reference to the centre of the comet, and we must ascertain whether its size is large enough for any part of it to extend to the earth's orbit.

"When this body appeared in 1805, the observations made by the celebrated M. Olbers, of Bremen, gave for the semidiameter of the comet two diameters and two thirds of the earth. From this number, compared with the preceding, it plainly results, that on *the 29th of next October, a portion of the earth's orbit will be comprehended within the nebulous atmosphere of the comet.*

"There remains now but one more question to answer, it is this: At the time when the comet will be so very near our orbit that the nebulous or hairy *atmosphere* will cover some part of it, *where will the earth itself be?*

"I have already said that the passage of the comet very near to a certain part of the earth's orbit, will take place on the 29th of October, before midnight; well, the earth will not arrive *at that same point,* until the 30th of November in the morning, that is, *more than a month afterwards!* Now we have only to call to mind that the average rate at which the earth moves in its orbit is 1620 thousand miles per day, and a very simple calculation will show, that

"*The comet of six years and three quarters will, during its appearance in* 1832, *be always more than forty-eight millions of miles from the earth.*

"In order to ascertain the least distance of the comet from the earth in its future returns, the same calculations must be made. If in this year, 1832, instead of passing the plane of the ecliptic on the night of the 29th of October, it reached that point on the morning of the 30th of November, it would certainly mingle its atmosphere with ours, and perhaps it would strike us. But I hasten to assure the public that a mistake of a month, in determining the time when a comet reaches its node, is impossible. I have confined myself in this ac-

count to what relates to the body of the comet, because no trace of any tail has ever been seen to accompany it in its former visits.

"The reader is now in possession of all that can interest him with respect to the course of the comet of October, 1832. The foregoing facts do not differ from those which M. Olbers published in a note, the meaning of which has been so strangely mistaken by the public and by several journalists. Shall I be more successful in my endeavours to explain myself? I hope so; but I cannot be very confident so long as there are persons who, believing that the earth will not come in contact with the comet or receive any direct injury from it, yet think that the comet cannot cross the earth's orbit without altering its form, as if this orbit were a material substance; as if the parabolic line described by a bomb through the air, when discharged from a mortar, could be affected in its course by other bombs having formerly been projected through the same space."

We find then that this comet will never be nearer to us than forty-eight millions of miles; within only twice this distance we perform our round unharmed about the great central fire, in obedience to the attraction of which the comet, as well as ourselves, moves.

As the calculation of our security from ill effects by collision with the comet rests upon the time at which it will intersect the earth's orbit, M. Arago proceeds, by way of rendering assurance doubly sure, to examine the causes which might be said to cast a doubt upon the conclusions which he has stated. The first of these alleged sources of error is the effect of a resisting medium in the planetary spaces, which, by retarding the comet in its course might be supposed to bring it *later* to the earth's orbit than the time calculated. As we see the velocities of bodies diminished by resistance, this idea seems at first plausible, and we abandon it only after finding the imperfect nature of the reasoning by which we drew our conclusions. The effect of a resisting medium would be to decrease the force by which the comet tended from the sun; it would therefore be drawn nearer the sun, and, hence, be made to describe a smaller orbit, and with an increased velocity. The effect then of such a resistance would be to cause the comet to arrive sooner, instead of later, at the earth's orbit, and in this case to increase the distance between it and the earth. Comets become interesting in a scientific point of view as enabling us to detect the existence of this very attenuated medium which fills space, and the experiments of modern astronomy are employed in studying the question. Already Encke's comet has shown in its frequent returns (every three and one-tenth years) a small acceleration of about two days, which Encke considers attributable to this cause.

It is not our purpose to follow M. Arago in the various questions which he examines; our readers who feel disposed to look over these will find wherewith to amuse and to interest, plainly set down; they will see that astronomers as well as poets give the rein to imagination, and will find, with them, how limited a view our intellect can take of the vast phenomena of nature.

It may not be amiss to state that M. Arago examines the following among other questions, and proves clearly by facts that a negative answer must be returned to each and every one.

Do comets affect the seasons? Was the fog of 1831 produced by the influence of a comet? Has Siberia changed its climate from a similar influence? Is it necessary to resort to the influence of a comet to explain the severe climate of North America?

We will not quit the subject without a word upon the (so called) lost comet of 1770. It affords a fine instance of the grasp of human intellect, and is well calculated to inspire us with confidence in the results of the calculations of astronomers. It shows us, also, how inconsiderable must be the masses of these bodies which once inspired such terror in our race.

Between the months of June and October, 1770, a comet was visible, the orbit of which was found, by calculation, to be an ellipse, in which the comet made an entire revolution in five and a half years. The facts that this comet, though of so short a period, had not been recorded as visible previous to this time, and that it was not visible in 1776 (five and a half years after its first appearance,) threw a doubt upon the calculations of Lexell, and induced the Institute of France to propose a prize for a complete investigation of its orbit, to include the perturbations to which it might have been liable. Burckhardt, by the aid of certain analytical formulæ of La Place, was enabled to solve the mystery which hung about this comet. The orbit found by Lexell was confirmed as the true one, and in tracing back the course of the comet in this orbit, prior to its appearance in 1770, Burckhardt ascertained that in 1767 it had been within the sphere of attraction of the planet Jupiter, the attraction of which planet, at the nearest approach of the comet to it had been three times that of the sun. By means of the analytical processes to which we have before alluded, Burckhardt was enabled to determine that had the comet been, prior to 1767, moving in a large orbit, of which the least distance from the sun was greater than that of Jupiter from the same body, and in which its period was fifty years, the attractive force of the planet would have been sufficient to draw it into its new orbit, the least distance of which from the sun was less than the radius of the earth's orbit. The comet was not seen prior to 1770 on account of its great distance from the earth, which distance, when at the smallest, exceeded that of the planet Jupiter. Next by following the comet in its orbit, in 1776, when it should have reappeared, Burckhardt found that the sun was interposed between the earth and the comet, so as to render the latter invisible. The non-appearance in 1776 was thus accounted for. But why has the return of this comet not been noticed? An answer was also given to this question. The time of revolution of the planet Jupiter in its orbit is about twelve years; hence in 1779 the comet came a second time within the influence of the attraction of the planet, but in different relative situations from those which had occurred twelve years before; the attraction of the planet was exerted sensibly for nearly five months, and the orbit was again changed. The least distance of this new orbit

from the sun is not nearer than the planet Ceres, and the time of revolution about twenty years. Unless this comet should again be subjected to perturbations bringing it nearer to our part of the planetary system, it cannot again be visible from the earth.

The inconsiderable mass of the body just spoken of, is proved by the fact that while the attraction of the planet Jupiter caused such entire changes in the orbit of the comet, the latter did not perceptibly affect the motions of the planet, and not even those of its satellites. We are prepared from these observations to expect the result which the calculations of La Place gave, in relation to the effect of this comet on the earth's motion, namely, that passing as near to the earth as fifteen hundredths of the earth's distance from the sun, and having its own period of revolution affected two days by the earth's attraction, the reciprocal effect upon the earth's motion was insensible.

B.

AMERICAN PATENTS.

LIST OF AMERICAN PATENTS WHICH ISSUED IN MAY, 1832.

With Remarks and Exemplifications, by the Editor.

1. For a *Mill for Grinding Grain, Paints, &c.;* William G. Johnson, city of Philadelphia, May 3.

This mill is to be constructed in the usual manner, excepting the apparatus for pressing the stones together, which apparatus, we are informed by the patentee, consists of a horizontal lever, a regulating screw, compound levers and weights, and a moveable and fixed collar.

In form and action this apparatus bears a near resemblance to the governor of a wind mill, or steam engine, but it is not made to revolve, being acted upon in another way. When the stone is raised, it presses against a lever, connected with the governor, and this throws out the two balls, or weights, causing them to act with greater force, upon the stone, and thus prevent its further rise. The effective pressure upon the stone is in this way increased, or diminished, as it rises from, or approaches towards, the bed stone. It is this particular arrangement which forms the subject of the claim.

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2. For *Applying Wind to the Propelling of Boats, Vessels, or Land Vehicles, Mills, Lathes, and other Machinery;* Benjamin Dugdale, city of Trenton, New Jersey, May 3.

The specification of the machinery employed does not make its structure clear, says nothing of its mode of operation, and lays no claim to any part of the apparatus. The drawing, in our judgment, throws but little light upon the subject, as it has not enabled us to perceive how the patentee intends that his machinery shall operate in propelling. Its general appearance is that of the horizontal wind mill, but we see no contrivance for feathering the sails. There is a

vertical shaft, from the upper end of which project ten, or more, horizontal arms, and a corresponding number at a proper distance below. Iron rods extend from the extremities of the lower to the extremities of the upper arms, thus forming the skeleton of a lantern. Sails which may be lowered or raised by means of pulleys, and which have rings on their edges that slide on the iron rod, form, when raised, pannels all around the lantern, and present to us a regular polygon. We leave to others to divine how boats, vessels, land vehicles, mills, lathes, and other machinery, are to be propelled by this contrivance. Could we discover in what way the wind is to operate upon the sails, we could tell how to apply their revolution so as to effect some of the ends proposed; even then, however, we should be obliged to leave the boats and vessels out of the question, unless we were permitted to locate our wind mill on the shore, and to extend a tow line from it to the vessels on the water.

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3. For an improvement in *Saddles*; George Pritchard, Clarksbury, Harrison county, Virginia, May 3.

Steel springs are to be formed by winding pieces of wire, of one-eighth of an inch in diameter and five feet long, round quadrangular bars of iron, five-eighths of an inch wide and three-eighths thick. Two of these springs are to be used with each saddle. They are to be fastened by one end under the cap plate, and on the head of the tree, and by the other to webbing attached to the cantle in the usual manner, thus giving a high degree of elasticity to the seat, which cannot exist when the webbing extends to the head of the tree.

The patentee alludes to other modes, previously patented, of fixing elastic springs to saddles, but considers that just described as more durable, and as preferable on several accounts.

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4. For *Machinery for Liming and Handling Skins in Tanning;* Caleb Hank, Monroe county, Virginia, May 3.

The machine for liming consists, in part, of a frame made in the manner of a bedstead, having cords stretched across as in the corded kind. Upon this net work the skins in the liming vat lie, and when they are to be aired they are raised by means of a windlass and pulley attached to a framing over the vat. Ropes descend and are hooked to staples in each corner of the liming frame for this purpose.

The handling apparatus is also supported on a frame over the vat. The skins are all attached to each other by ropes at their ends, and a part of the handling apparatus consists of a roller, turned by a crank, which roller extends across the vat, and is of sufficient length to receive the skins. Ropes from the upper skin are attached to the roller, and on turning this the continued sheet of skins is rolled upon it, the ooze falling back into the vat. There are some contrivances about this apparatus which we have not noticed, but what we have said exhibits its principal features.

5. For a *Self-regulating Horizontal Wind Mill;* Jeremiah Coleman, Vincennes, Knox county, Indiana, May 4.

We just now dismissed one horizontal wind mill because its physiognomy was not sufficiently expressive, or we were not sufficiently skilled in the science to enable us to judge of its disposition; and we are again called to encounter a wind mill which will also prove too much for us, or too little for the patentee. We, however, can give a pretty clear idea of its construction, and know that we have readers who will be thereby enabled to trace its operation, whatever it may be.

There is the usual vertical shaft of the horizontal wind mill, from the upper end of which four arms project in order to support the upper ends of the sails, or wings, and below them four others to sustain their lower ends. The sails, or wings, are made like doors, and, like them, turn, or are hinged upon one edge. A pivot passes from each of these wings into one of the upper, and another into one of the lower arms, and upon these they swing freely without any check or stop. The upper arms, however, are made several inches longer than the lower ones, so that the wings are not hung vertically, but droop, or swag, and there is a contrivance for increasing this drooping when desired; the lower end of the wing being hung on a sliding piece. This part of the contrivance the inventor calls "GRAVITY UPON WIND."

The running gear is to be the same as in any other horizontal wind mill.

The patentee says that "the above described mill is safe with almost any sized wings, as each wing, during a storm, stands with its thin edge to the wind."

The foregoing are all the data, and now let the machinists solve the problem of the action of this machine, and ascertain its comparative value.

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6. For an improvement in the *Grist Mill;* Oliver N. May, Hancock, Delaware county, New York, May 5.

This is another portable grist mill, differing from those which have preceded it in some points of arrangement which are claimed as new. The spindle is kept from rising in a manner like that of some which we have described as having on the lower end a projecting button or fillet with a collar or strap above it; the one now before us is more complex than those alluded to, but the end is attained in a similar way. Instead of weighting the runner directly, we are told that weight may be added to it by "casting the spindle large," and the doing this forms one of the claims. The principal novelty in this mill consists in what is called "a vibrating bolt." This is a frame which may be eighteen inches wide, five high, and of any convenient length; the bottom and sides of it are to be covered with bolting cloth, and the top with any kind of light cloth. This bolter receives the flour from the spout, is placed in an inclined position, and has a vibratory motion given to it from the action of the driving machinery of the mill.

7. For an *Artificial Sedlitz, or Rochelle Water;* Joseph Boston, city of New York, May 5.

This improved mineral water, or *aerated saline aperient*, the patentee calls "imitation Sedlitz or Rochelle water." To prepare it, twenty pounds of carbonate of soda are dissolved in twenty gallons of boiling water, and to this solution is added, in small repeated doses, to avoid too powerful an effervescence, an equal weight of bitartrate of potass (cream of tartar.) After this liquor has cooled it is to be put into a soda water fountain, and impregnated with carbonic acid. This, when taken with any of the usual sirops, becomes an agreeable and active aperient.

Seventeen pounds of common Rochelle salts, and three of the soda dissolved in ten gallons of water, will, it is observed, produce a liquid essentially similar; but when thus made it is more expensive than the first process.

The claim is to the discovery that the foregoing mixtures impregnated with carbonic acid, form a grateful and useful aperient.

To discover, has been defined to be the finding of that which was before unknown; thus viewed, the foregoing fact could not have been discovered by the patentee, as it was before well known. The only thing which could be legitimately claimed in the foregoing process, would be the impregnating of the aperient solution with carbonic acid by the same means which are employed for impregnating the so called soda water. The sedlitz powders may be made by mixing together one drachm of Rochelle salt, and fifteen grains of carbonate of soda, both in powder; and having in another paper twenty grains of tartaric acid. When these are dissolved in water contained in separate tumblers, you obtain something very much like the foregoing mixture impregnated with carbonic acid, and thousands of persons have *discovered* that it is a grateful and useful aperient.

Would not the economy of the process prescribed by the patentee be promoted by collecting the carbonic acid disengaged in making the mixture, and afterwards impregnating the fluid with it. This could certainly be effected by an addition to the apparatus, which might be made at a very small expense.

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8. For an improvement in musical instruments, denominated the *Seraphine, or Harmonicon Organ;* Lewis Zwahlen, city of New York, May 5.

This patent is taken for adding to organ pipes the vibrating springs from which the tones in the common seraphine are derived. A plate of brass, or other metal, is to be attached laterally to one extremity of the pipe, which is then to be fixed in the wind chest in the ordinary way. More than the usual degree of compass, volume, and softness, we are informed, can be thus attained. The patentee observes that the principle resembles that of the reed in the clarionet. Although we have seen this vibrating spring applied in wind instruments, played upon by means of keys, we are not aware that it has been used on

organ pipes, and cannot doubt that it may add to the instrument a very good and pleasing stop.

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9. For a *Plough;* Joseph Dudley, Fleming county, Kentucky, May 8.

The share and mould board of this plough are in one piece; the instrument is to be made of wrought iron, and put together with nuts, screws, &c. as directed, and when this is done it is then a patent plough.

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10. For a *Cooking Stove and Fire-Place;* Edward Potter, Providence, Rhode Island, May 8.

A cooking stove, having a grate for burning coal, a blower, a hole in the plate above the fire, and some of the other ordinary appendages of such affairs, is described, and the patentee then says that "I claim as my invention the before described cooking stove and fire place." We think that the invention must in this instance be microscopic, as we are unable to discover it with spectacles No. 14.

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11. For a *Board Shearing Machine;* Simon Willard, Cincinnati, Ohio, May 9.

This machine is intended for cutting laths out of boards, and also for cutting strips and splits for a variety of purposes. Narrow flooring boards, sixteen feet in length, are mentioned as intended to be cut by it.

An iron shaft of the required length is to be extended across a strong frame; for laths, this shaft need not, altogether, exceed six feet in length. On its ends there are to be fly wheels, and on its middle a whirl for driving it. Two cranks work a vibrating cutter, or long knife, up and down between cheeks by which it is steadied. The board, or other article to be cut, is to be fed beneath the knife, where it is supported on a fixed beam.

The claim is to "the combination of the machinery and shears, with the vibrating cutter, to the new and useful purpose of cutting boards, plank, or slabs, lengthwise, into plasterer's laths, narrow flooring, and weaving strips, or splints." The patentee adds that he claims only what he has invented that is new and useful. It is certainly right for an inventor to claim no more than what is new and useful, but it is for him to tell what he considers to be so; although such a declaration would not be a salvo in case of claiming too much, or include any thing described, that is not claimed.

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12. For a *Soda Fountain;* Andrew Kirkpatrick and James Fraley, Urbanna, Champaign county, Ohio, May 9.

This new edition of the (so called) soda fountain is, like the former ones, to have two reservoirs, one to contain a solution of carbonate of soda, the other an acid solution, and a double cock for uniting the two in drawing. There are to be smaller reservoirs for containing sirops, with cocks to draw them off; cavities are also provided to

contain ice, and a casing around the whole for receiving powdered charcoal, to preserve the temperature.

If the first patent of this kind was good for any thing, it has been violated by all those since taken, as its principal feature, the double cock, distinguishes the whole of them. This, we think, is the seventh patent, within a short period, for what is essentially the same thing.

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13. For a *Thrashing Machine;* Samuel Kable, Beaver creek, Green county, Ohio, May 10.

This thrashing machine is to be made with the ordinary cylinder and concave, and to be fed in the usual way, but the straw and grain are to be delivered from it on to a riddle, or screen, somewhat inclined, and kept vibrating by motion communicated to it from other parts of the machine. The patent is taken for this addition, which is, of course, intended to separate the grain from the straw. There are several thrashing machines which have appended to them an apparatus for separating the straw and grain by means of a riddle, and some of them are also furnished with fans for cleaning the grain: the present patent is, of course, confined to the particular arrangement adopted by the patentee.

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14. For a *Gas Lamp;* Solomon Andrews, Perth Amboy, Middlesex county, New Jersey, May 10.

(The specification will be shortly published.)

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15. For a machine for *Hulling, Cleaning, and Polishing Rice;* Joseph Beach, and Sylvester Starr, Middletown, Middlesex county, Connecticut, May 10.

In a tub, which may be about two feet in diameter, and four feet in height, nine polygonal rollers of wood are made to revolve vertically, one in the centre, and eight around this one. The centre roller may be made octagonal, and ten inches in diameter; the eight which surround it may be five inches and three-fourths in diameter, with the same, or a greater, or less, number of sides than the centre one. These rollers have gudgeons which work below in the bottom of the tub, and above in a cast iron frame fixed to the top of it. A cog wheel upon the centre roller meshes into smaller wheels on the small rollers, and when the centre roller is made to revolve it gives motion to the whole.

The rice is fed into the tub, and is to be hulled and polished by its friction against the rollers, and among its own grains. There is a gate at the bottom to allow the hulled rice to escape. The claim is to the above described combination of the various parts of the machine, so as to produce the intended effect of hulling and polishing the rice.

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16. For a *Machine for Shelling Corn;* William Gee, Templeton, Prince George county, Virginia, May 10.

A wooden wheel is made to revolve vertically, like a grindstone, but its shaft has on it a pinion upon which a toothed wheel acts in order to accelerate its motion. One side of the wheel is set with wrought iron teeth, and the ears of corn are borne against these by a spring board. The plank to which the working parts are affixed, forms an inclined plane down which the cobs descend as the corn is shelled.

The claims put in are to the manner of making the frame, and to the setting of wrought iron teeth into the face of the wooden wheel. This is what some persons might be inclined to call a "wooden contrivance," as machines acting upon the same principle precisely, have been long since made of cast iron, and if the patentee will do as we once did, and send to the Richmond foundry, in his own state, he may purchase a machine very much like his own, but better, because it is made of cast iron.

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17. For a machine for *Making Cooper's Rivets* from iron, copper, or other metal; George W. Sowle, New Bedford, Bristol county, Massachusetts, May 11.

The heated metal which is to be made into rivets is passed between two iron rollers, grooved so as to reduce it to the size of the shank of the rivets, and the metal is received by an apparatus which cuts off and heads it. From the nature of the machinery its description would require drawings to make it understood. The claim is to every part of the machine with the exception of the grooved rollers. The description, as given, is obscure, and the drawings themselves are not well executed.

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18. For *Paper for covering Buildings;* Frederick A. Taft, Dedham, Norfolk county, Massachusetts, May 11.

Paper is to be made by taking finely ground coal and sulphur, and mixing it intimately with the pulp, after which the sheets are to be formed in the usual way. After the paper has been dried it is to be passed between heated rollers, which will melt the sulphur, and render the paper impervious to water; other materials are to be sometimes employed for the same purpose, and the paper, instead of being rolled, may be pressed between heated plates, or put into an oven.

The proportionate quantities of the materials employed, may be one part, in weight, of fibrous stock, two and a half of brimstone, and two of coal. Salt and lime are sometimes added to render the whole less combustible.

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19. For a *Machine for Crimping Boots;* Silas Witherby, Essex, Chittenden county, Vermont, May 12.

A screw is made to force a follower down between the cheeks of a press: upon the follower are two pieces of plank which are forced down upon the crimp. The claim is to "the application of the screw;" and the whole description does not occupy double the space of our notice of it.

20. For a "*Safety Carriage;*" Robert Beale, city of Washington, District of Columbia, May 12.

(See specification.)

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21. For an improvement in *Napping Hats*; Joseph Dort, jr., William Wells, and Daniel Olmstead, Buffalo, Erie county, New York, May 12.

There is a tub of about three feet six inches in diameter, and sixteen inches in height; the bottom of this is to be covered with suitable cloth, and it is furnished with a cover fitting it steam tight. A vertical shaft rises in the centre of this tub and passes through the cover. This shaft may be made to revolve by means of a crank and bevelled wheels. From the shaft proceed arms which carry four conical rollers, in the form of hat bodies, that revolve on the bottom of the tub. The bodies to be napped, having the napping previously stuck on, are stretched over these cones, and over them suitable covers are then strained. When they are fixed in their places, the tub is covered, and steam admitted into it through tubes, the revolution of the cones being kept up during the scalding. More than one body may be placed upon a cone at the same time.

There is no claim made; the whole apparatus, it is presumed, being considered as new in its application.

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22. For a *Cooking Stove;* Horace Bartlett, Bridgeport, Fairfield county, Connecticut, May 12.

We apprehend, from the construction of this stove, that wood is to be the fuel burnt in it, as it is not furnished with any thing in the nature of a grate, but has a fire-place like that of the common kitchen stove. Above this fire-place is an oven furnished with folding doors, and having ledges upon which to rest tin plates for the baking of bread, &c. This, it appears, is an essential feature in the invention, as the patentee says, "I claim as new the construction of the oven so as to bake eight loaves of bread at one time, placing them in two or three layers deep. To accomplish this, and claim as new, I use a sheet of tin, which, being a non-conductor of heat, and raised from the bottom of the oven, prevent the bottom loaves from burning," &c.

One part of this discovery is certainly new; namely, that tin is a non-conductor of heat; but of the remainder we cannot say so much; the practice of baking loaves and other articles on tin, or sheet iron, is rather antiquated, and the placing them in tiers is not a thing of yesterday. How, and where, holes are left for pots, kettles, and frying pans, we shall not at present attempt to tell, as these parts resemble those for the same purpose in other stoves. Among the claims, however, there is one for "cramping the blaze into small tubes, by which the heat is conveyed off with much greater strength." The smoke escapes through semicircular openings on each side of the oven; and these flues are the small tubes into which the flame is

"cramped." The sides of the oven form the flat sides of these flues, and are heated by the flame passing through them.

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23. For a *Machine for Forming Hat Bodies;* Seth Graham, Fayette, Kennebeck county, Maine, May 15.

About three years ago, the patents obtained for forming hat bodies were very numerous; and since that time the processes of napping, stiffening, dying, and washing, have been the subject of various application. The forming machinery, for which the patent before us has been granted, does not differ, in the general principle of its action, from several others. The wool is to be delivered from a carding machine in a continued fleece, and received upon two conical formers revolving against a double conical roller, the fleece, or sheet, being cut along the middle as it winds upon the bases of the conical former.

To give the required crossing direction to the fibres of the wool, the apparatus carrying the rollers, receives a vibratory motion in a way differing from that in which the same end has been attained in other machines. To describe the mode of doing this would require more space than we can conveniently devote to it. The specification ends with the words, "the machine above described I claim as the first and sole inventor." As most of the parts are used in the same way, and for the same purpose, as in other machines, this claim appears to be rather too broad.

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24. For a *Machine for mixing Clay and Mortar* for making bricks, and other purposes; David Phillips, Natchez, Adams county, Mississippi, and John Drummond, Whitestown, Oneida county, New York, May 15.

A wheel is made to revolve in a circular trough, in the ordinary way, and may be four or five feet in diameter, and about one foot thick. Its periphery is covered with plates of iron cast in segments and fastened around it. These segments form circular cutters, or knives, all round the wheel, the blades being about eight inches wide, and having a space of an inch and a half between them. To prevent the clogging of these spaces a comb-like cleaner, supported on a piece of timber attached to the shaft, scrapes between them, while water from a reservoir, also fixed on the shaft, drips upon the clay. The claim is to the before described machine, and particularly to the mixing wheel with blades, and the manner of cleaning them.

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25. For *Coating Lead Pipes with Tin;* Thomas Ewbank, city of New York, May 16.

(See specification.)

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26. For *Preparing the Fillers for Cigars* by a machine called the Filler Breaker; Joseph Maffet, Lancaster, Lancaster county, Pennsylvania, May 16.

This machinery is too complex to be accurately described without

a drawing; but the object of it is to roll tobacco for the filling of cigars. For this purpose there is an endless revolving apron, made of leather, or other suitable material, upon which the tobacco to be rolled is spread. This apron passes, by its revolution, under a piece of sheet iron, called the guide, and in doing so the tobacco is rolled, and when there is enough to form a filler, it is broken off by hand, and the operation continued. The claim is to "the before described machine."

We think that this instrument might be simplified, and considerably altered in its combinations. Would it then be "the before described machine."

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27. For an improvement in *Andirons;* William Wilson, Greenfield, Franklin county, Massachusetts, May 16.

In this andiron, the front, or upright part, and the bar and back foot part, are made separate. They are to be put together by means of a wedge-formed dovetail on the front end of the bar, which falls into a corresponding recess formed by projecting cheeks on the back of the upright part.

The advantages of this mode of forming are said to be facility of packing; more easy manufacturing; increased strength, and economy in use, especially when made of cast iron, as one part can be renewed when the other is broken, or burnt out.

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28. For an improvement in the *Paddle Wheel* for steam boats, &c.; John Sheffield and Jonas Ingraham, Buffalo, Erie county, New York, May 17.

We see not the slightest variation in principle, and very little in arrangement, between this paddle wheel and such as have been repeatedly proposed, patented, and essayed, both here and in Europe. The object is to preserve the paddles in a vertical position, and the means of effecting this is the employment of a wheel eccentric to the shaft of the paddle wheel, pins, or cranks, from which act upon the buckets, that are connected also to the rim of the main wheel.

The specification describes the whole very clearly, without, however, taking the slightest notice of the fact that similar wheels have been heretofore made, or furnishing any thing in the form of a claim. A person ignorant upon the subject, and reading this specification, would at once conclude that the whole thing was a new contribution from the arcanum of mechanical science. Such wheels, however, have had fair and long continued trials, but have not been found in any respect superior to the common paddle wheel, whilst they are much more expensive, increase the friction greatly, and, from their complexity, are very liable to derangement.

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29. For an improvement in *Fire Arms;* Joseph W. Plummer, and John Clark, Wayne, Jefferson county, Ohio, May 17.

There is to be a magazine in the breech of the gun, which is to contain powder; and, when the gun is to be loaded, a portion of this

powder is to be conveyed, by an apparatus contrived for the purpose, into the barrel. There is an opening in the under side of the barrel, just above the charge, which is closed by a screw, with a crank handle adapted to it. The trigger guard is made to slide back, and to carry with it what is called the charger, which is an iron chamber fitting on the under side of the barrel; when this is drawn back, it receives powder from the breech, and when pushed forward carries it under the hole in the barrel, which has to be turned over to allow the powder to fall in. The ball is afterwards to be inserted, and the screw turned into its place.

There is also a funnel shaped magazine for priming powder, it being made self-priming by the action of the cock.

These parts constitute the *improvements*, which term, however, we think a misnomer. We had supposed that magazines for priming powder were exploded by workmen in consequence of their liability to explode themselves after a gun has been sometime in use. The percussion powder used in such chambers corrodes the gun, whilst the fulminating mercury employed in the percussion caps is free from that objection. Should the charged mine, in the breech of this gun, be accidentally sprung, it would make sad havoc. The loading near the breech at a hole closed by a screw is an old contrivance, and the form in which it is here presented, although it may be new, does not appear to be an improved one. These are a few of the objections to the said contrivance which present themselves to us, the remainder we will not offer, being unwilling to lengthen the catalogue, and shall be most happy to withdraw these, when we see good cause for so doing.

The claim is to the "method of loading, priming, and firing guns, rifles, pistols, and all kinds of fire arms, by means of the magazine, sliding charger, and percussion tube."

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30. For an improvement in *Making Rifles;* Joseph W. Plummer, and John Clark, Wayne, Jefferson county, Ohio, May 17.

This patent is taken for a tool for rifling barrels, and we regret to say that we do not think more favourably of the method of fluting, than we do of the construction of fire arms, patented by the same gentlemen.

Three or more pins, or cutters, are to be made of cast steel, with projecting threads on them having the twist intended to be given to the rifle. These pins are to follow each other successively, as they are to be driven through the smooth bored barrel by a hammer and punch.

We should greatly prefer the rifling machines usually employed, and are much mistaken if the judgment of workmen in general will not coincide with ours. These pins will undoubtedly operate, but not more rapidly than the tools already known, and should one of the cutting threads chip in driving forward, others would be likely to share a similar fate in driving it back.

The claim is to the rifling of guns by means of such pins.

31. For an improvement in the *Striking Clock;* James Bogardus, city of New York, May 18.

This improvement in the striking clock consists, in part, in the winding up of the two barrels at the same time; for this purpose they may both be placed on the same arbor, and they are then to be so connected that when winding they shall be acted upon together, but when discharging they shall act independently of each other. After the mode of doing this has been described, we are informed that "the barrels may be placed on separate arbors as in common clocks, if desirable," and in this case nothing is said of connecting them so as to wind together, although the winding together is one of the two points claimed; the other is "the method of arranging the stop, by which the machine is simplified." This part is very indistinctly described, and the drawing lends no great aid to the description.

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32. For an improvement in the *Door Lock;* James Kyle, city of New York, May 18.

The parts of this lock upon which the patentee rests his claim cannot be accurately described without a drawing, although a general idea of its mode of action may be given. The bolt is shot forward by a spiral spring acting against it, and it is intended to be used as a spring door lock, the bolt being moved by turning a handle in the usual way. The lever on the handle, works in a mortise made entirely through the bolt, which mortise is sufficiently long to allow the bolt to be drawn back, and clear the catch, or box.

Behind the bolt there is a number of flat, thin levers, made of plates of metal, and working on a pin. Each of these has a projecting piece on its end which falls into a notch in the bolt, retaining it in its position. The catch pieces upon these levers differ in length, and they require, therefore, to be raised in different degrees in order to disengage the bolt and allow it to act. The key has on it a number of projecting pieces, or cams, corresponding with the number of levers, each of which is to act upon its proper lever and raise it as a latch is raised. The projecting pieces on the key are formed of thin metallic plates like that of the lever latches; these slide over the shank of the key, and are secured by a nut on its end; this is done for the purpose of giving to them an arrangement corresponding with that of the levers, which all work upon one common fulcrum, and are susceptible, therefore, of an almost infinite variety of changes, the cams also can be so changed as to act with them.

The claim is to the whole of the before described lock, with the exception of the stock, and the spiral spring under the bolt.

Although the principle of a number of levers, or tumbles, falling into notches in a bolt, and the raising them in different degrees by means of the key, is not new, the arrangements by which this is effected in the present instance, we think sufficiently so to become the foundation of a valid claim.

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33. For a machine for *Making Brush Handles,* Rake Han-

dles, &c. Evans Tuck, Harrisburg, Dauphin county, Pennsylvania, May 18.

The timber is to be rounded by a tubular plane, equal in length to the handle to be formed. This plane is made of four pieces of stuff, which, when fixed together by suitable bands, form the tube through which the timber is to be forced. Upon each section of the plane there are eight irons, the first of which merely takes the angles off the square stuff, whilst the whole of them, acting in succession, reduce it to a round stick.

This plane is placed at the end of a trough in which the square stick is laid, having behind it a follower or rod, which is forced up by any adequate power, and drives the stick entirely through the hollow plane. The trough may be so high as to contain a considerable number of such sticks, which fall successively into their places as the follower is withdrawn. The patentee thinks that by the application of sufficient power, a stick may be rounded every second.

The power which will suffice to force the stick against thirty-two irons at once must be considerable, and a motion so rapid as that spoken of would create no small degree of heat; too much, we think, for the temper of the irons. The most formidable objection, however, to this machine, we should apprehend, would be its liability to choak, and the difficulty of clearing it out; but it is to be presumed that the patentee has satisfied himself on this point. We have seen sticks and handles of the kind named turned by means of a very simple apparatus; not so rapidly indeed as above indicated, but at the rate, we believe, of at least one in a minute.

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34. For an improved *Winnowing Machine;* James Ruple, Washington, Washington county, Pennsylvania, May 19.

The parts of this machine are generally the same with that of others for winnowing and cleaning grain, and we should think it time spent to little purpose to attempt to point out the particular differences; we shall therefore content ourselves, and, we presume, meet the approval of most of our readers, by giving the claim.

"What I claim as new, and of my own invention or discovery, is the formation of the screen, and the manner of shaking and using it; and the cant boards under the shoe to prevent the grain from scattering."

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35. For a *Machine for Dipping Candles;* John Aborn, city of Trenton, New Jersey, May 19.

A vat is prepared for holding the tallow into which the wicks are to be dipped; it may be made of copper, and of such dimensions as are required in the operation; it is surrounded by a tight wooden box, between which and the vat, steam from a boiler is to circulate, for the purpose of heating it. A reservoir for supplying the vat is constructed, and heated upon similar principles. The main part of the apparatus, however, consists of a frame of any convenient length, and wide enough between its sides to admit the sticks upon which

the candles are arranged, and the carriages which support them; the dipping vat stands at one end of this frame. A double rail-way, one placed above the other, extends along the frame; and by means of a windlass, the connected carriages, each supporting a row of sticks, are advanced towards the vat, when they arrive there, the candles are dipped, and placed upon the lower rail-way, and carried back, to be again returned. There is a contrivance for weighing the candles, which consists of a long lever extending from front to back, along the upper part of the frame, and supported on fulcra like a scale beam; several other matters of detail are also noticed by the patentee, as a wicking frame, &c.; in point of detail, however, the description is defective, leaving too much to be re-invented by any one who should attempt to construct the machine with no other aid than that which is afforded by the specification.

The claim is to the before described machine, and particularly to the rail-ways, the balance beam, the carriages, the sliding frames, the slides with catches, the wicking frame, and the lever for hoisting and weighing.

The objection to this form of claim is, that after including the whole machine, it particularizes certain individual parts, which, if the whole arrangement is new, is altogether unnecessary; whilst if the whole is not new, the general claim would endanger the validity of the patent.

Specifications of American Patents.

Specification of a patent for Coating Lead Pipes with Tin. Granted to Thomas Ewbank, *city of New York, May* 18, 1832.

To all whom it may concern, be it known, that I, Thomas Ewbank, of the city of New York, have invented a mode of coating lead pipes with tin, in a more effectual manner than has been heretofore done, and by which the danger attending the use of such pipes for the conveyance of water, and other liquids, is obviated, whilst their cost is but little enhanced; and that the following is a full and exact description of my said invention.

I take the lead pipes, *after they have been drawn to the required size*, and I coat them with tin, either on both sides, or on the inside only, as may be desired. To do this I prepare a bath of melted tin, in a vessel of a suitable form and size, which may vary according to the size of the pipe to be tinned. I regulate the heat of this bath, so that the tin shall continue in a fused state, without becoming sufficiently heated to melt the lead. This may be ascertained either by the use of a thermometer, or by testing it by a piece of lead, or by such a mixture of lead and tin as will fuse at a given temperature: with a little experience, however, a workman will not find any difficulty in accomplishing this object without such aids. When the pipe is to be tinned on the inside only, I cover the outside with lamp-black and size, or with any other article which will prevent the ac-

tion of the tin upon it; I then blow powdered rosin into the pipe. When it is to be tinned on both sides, the rosin is to be blown, or otherwise passed into the pipe, and the outside also is to be sprinkled with it, and it is then ready for the process.

The melted tin should be kept covered with rosin, fat, or other suitable article, to prevent its oxidation, and to aid in the tinning. All that is necessary is then to pass the pipe through the melted tin, which, when the pieces are not of considerable length, may be easily managed by hand; or when of considerable length and weight, a rope and pulley, or any other suitable mechanical contrivance which the workman may prefer, may be resorted to.

I am aware that the coating of lead pipes with tin, simply, is not new, the same having been heretofore done, but in a manner less perfect than that which I have just described. The lead has been tinned in sheets, and afterwards made into pipes, or the pipes have been made and tinned, and afterwards drawn to the intended size. By neither of these processes, however, is the intended security obtained with the same certainty as by my process of tinning the pipes *after* they are otherwise finished. The coating of tin is thus rendered more perfect, and those fissures are avoided which the former processes can scarcely fail to produce.

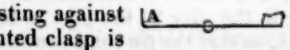
I do not, therefore, claim as my invention the mere tinning of pipes made out of lead, but what I do claim is the tinning such pipes after they have been drawn to the proper size, as is hereinbefore set forth.

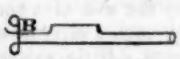
THOMAS EWBANK.

Specification of a patent for a mode of detaching horses from a carriage, either when running away, or whenever it may be desirable to effect that object, rapidly. Granted to ROBERT BEALE, *city of Washington, District of Columbia, May* 12, 1832.

Be it known, that I, Robert Beale, of the city of Washington, in the District of Columbia, have made an improvement in carriages, by which the horses may be suddenly disengaged when running away, or whenever required to be detached from the carriage quickly; called the safety carriage; which is described as follows.

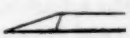
The swingletree is attached to the cross bar by an iron fixture called a jointed clasp, formed as in the annexed figure; the knee part, marked A, resting against the back of the cross bar. This jointed clasp is held up against the underside of the cross bar by an iron shutter, or hinged clasp, formed thus, turning on a joint, or hinge, secured to the underside of the cross bar. To the end of the hinged clasp is attached an iron rod, or bolt, B, with an eye at its end. This rod, or bolt, passes through an opening in the cross bar, and has an iron spring key inserted through the eye, resting on the upper side of the bar, which secures





the jointed clasp from dropping; or the rod may be fixed permanently to the cross bar, projecting far enough below it to pass through a slot or mortise in the end of the hinged clasp, with a spring key inserted through the end of the rod, or bolt, to prevent the hinged clasp falling. To the end of the spring key is attached a cord which leads inside of the carriage, where it hangs loosely. Should the horses take fright, and become unmanageable, the cord is then to be pulled suddenly, which will draw the spring key from the eye of the rod, or bolt, let the hinged clasp fall, and with it the jointed clasp attached to the swingletree, and will disengage the horse from the carriage.

The tugs are open in front, thus, to allow the breeching to slip off freely. This breeching is made from a single strap of leather, with rings sewed to the ends, to hook over the tugs.



The shutter, or hinged clasp, may have its end turned up at right angles, and formed like a catch, or hook, and secured by a spring, fastened to the side of the cross bar, the cords being attached to the end of the spring. The shutter may, indeed, be held up in a great variety of modes, but the before described are sufficient to show the principles of my invention.

When it is desired to retain the swingletree, and let the horse go off with traces only, then a hinged clasp must be put on each end of the swingletree, with the jointed clasps secured to the ends of the traces, and the cords attached to the spring keys run through pulleys and are joined to the cord which leads inside of the carriage.

In the two-horse carriage, the shutters, on hinged clasps, are hung on the under side of the wheppletree, and the cords attached to the spring keys run along on the top of the whippletree in a straight line, then pass around pulleys, and are joined to the single cord which leads inside, or outside, of the carriage. The pulleys are to cause the cords to run freely, and to draw the spring keys, or pins, from the eyes of the rods, or bolts, in a straight line.

An iron tube, with a flanch on one end, is fastened to the end of the pole. Over this is put a thimble, having a ring on each side, to which the breast straps are attached. This thimble slips off the end of the pole, when the horses are disengaged.

The mode of detaching the horses from the two-horse carriage is similar to that described for a single horse carriage.

In a four-horse carriage the leaders are disengaged from the pole in the same manner, by a jointed clasp, hinged clasp, spring key, and cord, as described for a two-horse carriage. The jointed clasp may be held up against the cross bar by a pin inserted through the jointed clasp into the hind part of the cross bar, to which pin the cord is attached.

The jointed clasp may also be secured by a spring fastened on the hind part of the cross bar, the cord being attached to the end of the spring. Springs, or friction levers, are secured to the carriage, and brought in contact with the hub in order to decrease the motion of the carriage when the horses are liberated, or before they are liberated.

This invention may be applied to field artillery, and it will enable the men to limber or unlimber the gun in less than half a minute. It may also be applied to wagons of every description, to ploughs, and harrows, and all kinds of agricultural implements drawn by horses, when required to be taken in haste from the carriage to feed, &c.

A forked piece of iron is suspended over the hound and front axletree to prevent its turning on the body bolt.

What I claim as my invention, and which I wish to secure by *letters patent*, is the before described apparatus for suddenly disengaging horses from carriages.

For a further illustration of my invention I would refer to the models and drawings of the same deposited in the patent office.

ROBERT BEALE.

ENGLISH PATENTS.

Patent granted to GEORGE LOWE, *for an improvement in the manufacture of Gas for Illumination.*

Mr. Lowe may lay claim, and justly, not to one only, but to a series of four inventions, each ingenious and useful, and in combination very valuable.

His first object is to purify the gas—his second, to evolve a greater quantity of a superior quality from the very same proportion of material, and in the very same period of time—his third object, to show the means of securing his first without new efforts—and his fourth is very similarly connected with the second, and includes the application of the whole apparatus to the attainment of the great end.

His stove is of three retorts, the section of each being a parabola. The furnace is as usual; but if, mechanically, his invention be ingenious, it is also chemically profound. He proposes to introduce atmospheric air, heated to 700 degrees of Fahrenheit, or even hotter still, either above, or over the surface of the fuel in the retorts, to bring it in contact with the sulphuretted hydrogen gas cooled from the coking coals in the retort during the process of their decomposition, and with the other gaseous and vaporous exhalations from lime-dreg water, ammoniacal liquor, and other fluids introduced under the furnace. By the combination of the atmospheric air (heated as we have said) with these gaseous evaporations, and their consequent ignition, he produces a sulphuric acid, which, mixing with the pure gas intended for illumination, as it passes the mains, &c. purifies it of those deleterious matters which have hitherto so lessened its brilliancy, equability, and utility. To effect these purposes he has a vessel with lime-dreg water, and one with ammoniacal liquor under the furnace; he has a flue or passage beneath, or at the side of the furnace for the entrance of the atmospheric air, affording the

means of heating it to the high temperature we have already stated, and a series of passages from this flue, or tube, into the furnace above the fuel, and over the surface of the burning mass in the retorts. A current of steam is introduced before the gas is conducted to the condenser, and affords, of course, a powerful aid to the purifying agency we have already described.

The second part of the invention consists in having retorts of exactly double the length of those in common use, and capable of being opened at both ends. Suppose, then, that the charge is intended to be one of eight hours, as usual: instead of putting in at once the whole quantity of coal, or coal tar, from which the gas is to be educed, Mr. Lowe would open one end of his retort, and put in exactly half the quantity; then at the end of four hours he would open the other extremity of his retort, and admit the other half. At the end of the next four hours, he would draw half the charge, and this process he would repeat at each end of the retort, alternately every four hours for a charge of eight hours, and every three hours for a charge of six hours. The advantage of this process is, that while every particle of the coal is allowed the same time, and the same means as are given by the common method for its decomposition, the gas evolved from the fresh coal mixes, and is combined with the riper gas from that portion which has had eight hours of burning time, that is, (for we could not be figurative,) eight hours of burning, to breathe out the gas. The coke, after this gas has exuded from it, is submitted to another process, by which all that remains is obtained: and by the interposition of steam, sulphuric or muriatic acid, and the carbonate of potash, the former applied as before described, the latter introduced over the coke in the retort, or the fuel in the furnace, is purified as at first.

The fourth invention is the retort, of its new length and shape; the furnace with its atmospheric air flues, and its troughs of ammoniacal liquor and lime-dreg water; the condensers, with their steam cocks, and inner plates and pipes, and all the apparatus by which the effects we have imperfectly described, are admirably brought about. The gas is purer, in larger quantities, and is produced in the same time, and at a less expense of labour and material, by the inventions of Mr. Lowe; and it is exceedingly probable that the whole, or the greater part, of his improvements will be introduced to general use in all gas works.

[*Rep. Pat. Inv.*

Specification of the patent granted to Moses Teague, *Iron Master, for an improvement in the making and smelting Pig Iron. Dated January* 17, 1831.

To all to whom these presents shall come, &c. &c.—Now know ye, that in compliance with the said proviso, I, the said Moses Teague, do hereby declare, that the nature of my said invention,

and the manner in which the same is to be performed, is particularly described and ascertained by the following description thereof, reference being had to the drawing hereunto annexed, and to the figures and letters marked thereon, (that is to say:)—

This improvement consists in making use of, or employing the flame and heat (heretofore discharged into the open air) from the tops or tunnel heads of blast furnaces or cupolas, used for the making and smelting of pig iron, by means whereof the said flame and heat is made to act upon the ores, mines, and minerals, about to be smelted, previous to the same being deposited into the interior of the furnace or cupola. The material is thereby acted upon with additional heat, which would otherwise pass away without producing effect, and the preparation for smelting so much forwarded as to require considerably less fuel, blast, and time in the operation. The method of applying the same is by diverting the flame and heat (usually passing out of blast furnaces or cupolas, into the open air) and causing the same to pass in, upon, or through, one or more ovens, stoves, buildings, or erections, to be fixed in, or upon, or near to, or adjoining, the tops or tunnel heads of the said furnaces or cupolas; which said ovens, stoves, &c. &c. are made to contain certain portions, quantities, or charges, of the materials intended to be smelted, which, being previously deposited therein, the heat and flame so diverted are made to act thereon. The said flame and heat diverted from its usual course, and driven, or discharged into, or through the said ovens, stoves, &c. &c. by partially contracting, or stopping up altogether, the tops or tunnel heads of the said blast, furnaces, or cupolas, either permanently with brick, mason's work, or any other mode, or by one or more moveable dampers, doors, or valves, to be fixed on, in, or upon them, or the said ovens, stoves, &c. &c. By this means the flame and heat is diverted, and caused to pass into, or through, the ovens, or stoves, which have one or more chimnies, or flues attached thereto, in order to carry off the superfluous heat, flame and sulphur.

The shape, size, and number of the said ovens, stoves, or chambers for containing the ore, mine, or mineral, might be varied according to the size of the furnace, or cupola, and the quantity of materials used in each load or charge, but the more surface can be obtained (provided a sufficient quantity of heat and flame can be brought to act thereon,) the better, as the materials to be smelted can be more thinly spread, and, consequently, present a greater surface to be acted upon by the said heat and flame.*

* In the Repertory of Patent Inventions, for July last, from which the above is abstracted, there are drawings exhibiting various modes in which the patentee intends to carry his plan into effect, to which we must refer those interested.

Patent to W. Hale, *Machinist, for improvements in machinery for Propelling Vessels, granted October* 13, 1831.

The improvements in propelling proposed by Mr. Hale, consist in driving water forcibly out at the stern of the vessel under the water line, by means of a rotatory apparatus, somewhat similar to the rotatory blowing and winnowing machines.

In the 5th volume of the present series of the Register of Arts, p. 67, we have given a description of a patented invention of Mr. William Hale for raising or forcing water for propelling vessels, and the present patent has been taken out for a modification of the same method, therefore we refer our readers to the former description to obtain a general idea of the plan.

In his second patent Mr. Hale makes the exterior casing of the paddle box to recede from the centre spirally, constituting a curve whose distance from the centre of motion at its outer extremity exceeds the distance at its inner extremity by the space or opening made for the escape of the water from the box. The water is admitted into the box through openings near the centre, in the manner usually adopted for the supply of air to the blowing machines. The propeller, or vane, which puts the water in motion through the medium of a steam engine, or other first mover, consists of a single lever receding spirally from the axis, or centre of motion. The motion of the vane is in the direction to cause the water within the box to recede from the centre, and escape finally in a direction which is a tangent to the curve; or its motion is towards its back, or that part farthest from the centre. The patentee does not, however, confine himself to the spirally formed vane, but proposes several other modifications of the moving or propelling part of his invention; such as placing a series of oblique paddles, or propellers, on arms extending from the centre of the apparatus, as in his former patent; and these he again proposes to vary, according to circumstances, in number, magnitude and position.

This propelling apparatus is placed near the stem of the vessel, with the axis in a vertical position, and the opening at the circumference of the paddle box made to communicate with the water in which the vessel floats through an opening in the stern, while the openings near the centre of the box are made to communicate with the exterior water through the bottom of the vessel.

The application of the invention to raising or forcing water, is effected by connecting the induction openings with the well or reservoir from which the water is to be raised, and a delivery pipe with the eduction opening, and thus the machine becomes a rotatory pump. [*Reg. of Arts.*

Patent to R. W. Sievier *for improvements in the manufactory of Cables, Ropes, Lathe Bands, &c. granted December* 1, 1831.

The ingenuity of this patentee has been developed much more extensively in finding applications for his invention than in the invention itself, which simply consists in the application of strands of caoutchouc, or Indian rubber, instead of strands of hemp or flax, in the manufacture of ropes. The Indian rubber is to be separated into slips of appropriate dimensions, and then drawn out till they are reduced to the thickness required for a strand. Seven, or any other convenient number of the strands, are then placed together longitudinally, and secured together by hemp, flax, cotton, woollen, or other fibrous substance, or by straps of leather, or other suitable material, being woven, knitted, netted, or plaited over the Indian rubber strands. In the manufacture of larger cordage, seven, or any other convenient number of the last are to be bound together in a similar manner, and then as many of this second size are to be united as shall make a cable, if required.

The other purposes besides the cables, ropes, whale fishing and other lines, to which this invention is said to be applicable, are travelling bags, purses, or similar articles, where the difference of the magnitude of their contents renders elasticity in the containing bag of importance. [*Reg. of Arts.*

Specification of the patent granted to John Samuel Dawes, *Iron Master, for certain improvements in the manufacture of iron. Dated December* 22, 1831.

To all to whom these presents shall come, &c. &c.—Now know ye that in compliance with the said proviso, I, the said John Samuel Dawes, do hereby declare the nature of my said invention, and the manner in which the same is to be performed, (that is to say:)—

My improvements in the manufacture of iron are applicable to the processes of smelting, remelting, &c. and consist of, or in, the introduction of certain materials at the bottom or lower part of the blast furnace or cupola, and in continuing such introduction during the above mentioned operations of smelting, remelting, &c. in addition to the usual method of charging the said furnaces at or near the top or tunnel head, by which means I consider that I am enabled to make a larger quantity of iron, of superior quality, with a less quantity of fuel, and with less expensive materials than are commonly used, such as coal uncoked, iron-stone untorrified, &c.

The materials which I use (at the lower end of the furnace,) consist of charcoal, or any other fuel applicable to the purpose, together with any of the well known fluxes, such as alkalies, alkaline earths, lime, metallic, or other, oxides.

The means by which I now effect the introduction of the said fuel and other substances, consist of a conical tube, or feeder, (into which

the said materials are thrown,) fitted to the top, and projecting a little behind the mouth of each blast pipe, (the blast pipes being in the usual situation,) which tubes, or feeders, together with the said blast pipes, communicate with the furnace through large water tuyeres or tue irons, or they may be introduced at any other part of the lower end of the said furnaces, as shall be found best suited to the purpose.

[*Rep. Pat. Inv.*

Patent granted to PIERREPOINT GREAVES, *for making ornamental or fancy Cotton Yarns and Threads, applicable to the making, sewing, or embroidering of Cotton, and other Fabrics. Dated December* 22, 1831.

The skilful combination of the primary colours, so as to produce new shades or self-colours, has proved a puzzling point for the dyer; nay, it is held impossible, by a mixture of dies to produce certain tints in cotton. It is of some importance that this difficulty should be got over; silk embroidery and worsted tapestry, have long been foster sisters to painting; woollen rags have been dexterously made into pictures, and tattered red coats are manufactured into a brilliant tint, but the arts of design have received few favours from cotton, while Manchester and Glasgow know how much cotton owes to the ornaments with which art has loaded it. Now, there is reason to hope from this discovery of Mr. Greaves, that the minutest shades of colour may be produced in cotton yarn and thread; and that future tapestries and brocades, and embroideries, and tambourings in this elegant material, may be manufactured with all the advantage of varied tints, as well as all that grace of *drawing* which some productions in cotton have already manifested. This discovery is not only ingenious and useful, but it is capable of an easy explanation, and may be made clear in few words, with little trouble to the understanding. Mr. Greaves procures a quantity of cotton wool, dyed as usual in each of the primary colours, and without the aid of any machinery, without the slightest additional expense, with no more than the common quantity of labour, he produces his novel and variegated store. He uses the wool as a painter would do the earths, which are called colours from the colours they bear. He takes, for instance, a portion of blue wool of a deeper or a lighter shade, and a portion of pink wool, and mingles these together until the mass is purple, adding red or blue according to the tone he seeks. If he wish to produce a delicate green, he uses a proportionate quantity of blue and yellow; these colours he can make darker or lighter by the addition of a deeper blue up to black, and a paler pink or yellow down to white, for white and black wool may be mingled with the prismatic coloured wools just as they may be with the primary colours in the earths for painting. When he has brought his mixture to the tone he wants, he deals it out to the spinner in the usual quantities, and after it has gone through the common process, and is made into

yarn or thread by the usual means, it retains that tint which the wool acquired by its regular admixture; and thus any work of weaving or sewing in tapestry, tambouring, or embroidery, may be wrought in cotton with the highest degree of perfection.

To copy the finest painting, in cotton, is no longer a matter of insuperable difficulty; and as the task must be delightful, we may well expect some new Miss Linwood to give her attention to a subject so interesting. It is a matter wholly in the hands of the ladies. If a picture be fairly studied—one of the Madonas of a Raphael, for instance—and the necessary colours and shades, and tints noted, and sent to Mr. Greaves, he would no doubt furnish the required quantity of material in the due proportions, and by dint of talent and industry an excellent copy might be produced.

Again, in dresses, what improvements may not be wrought when the trimming and the dress are of the same fabric. In furniture for the bed room, or the sofa, or the chair cushion, what elegant devices may be adopted. The designs of Flaxman, in the frames of Corbould, may yet shine in cotton colours on a music stool, blending nearly all the arts. In shawls, too, how much delicacy will be gained by the new self-colours, and how rare the tints thus to be produced. What enamel is to painting, cotton tapestry may be to that of woollen. We shall have arras hangings again in all probability; at least the *agrémens* of the boudoir may be heightened by this discovery of Mr. Greaves. The new tapestry should be called Pierrepoint. [*Rep. Pat. Inv.*

Patent granted to Claude Marie Savoye, *for improvements in Mills for grinding and reducing Grain. Communicated from abroad. Dated December* 15, 1831.

The inventor desires you to suppose a large solid ring, or hoop, of cast iron, or other metal; it is to be straight and equal on its outer side, as if part of a cylinder, but inside bevilled, or inclined as if a section of a cone: on the upper part of the inside of this ring is cut a series of sharp teeth, which project considerably at their points, and taper down, till they become smooth and equal with the common surface of the metal; or, to use the workman's phrase, quoted in the specification, "diminish till they terminate in nothing." Just at this point, however, there are small gutters, or channels, cut in the iron, at the root of each tooth, and at an angle of inclination; these are to allow the bran or residuum of the corn to pass away, and also to admit air. To the lower edge of this ring are attached "lugs" or ears of solid metal, by which it is to be secured horizontally into a timber frame, of great solidity. This ring represents the nether mill stone. A second ring of the same metal and of equal solidity, but of a less diameter, and of a conical shape, outside, where a set of teeth, corresponding with those of the inner circle of the last described ring, are cut, is made to fit into and act concentrically within it. The serrated sides work against each other, the teeth being, therefore, of course, set differently, those of the inside of the large ring turning their points

one way, those on the outside of the smaller ring turning their points in the opposite direction.

The action is rather cutting than molar, and resembles that of a pair of scissors, more than that of mill stones. However, these rings supply the places of grinders. When the outer circle has been securely fastened by its lugs, or ears, to the beam, or frame of timber we have mentioned, a spindle, or axis, is secured into the centre of the inner ring. It works in a tube, or case, which passes upwards to where an extinguisher-shaped cap surmounts the whole, and downwards to its resting place on a lever, by which the degree of contact between the two rings is regulated. For it stands to reason that very coarse grain might lift the inner ring out of its position, and very fine grain might pass between the rings unground. This is prevented by the lever we have spoken of, the fulcrum of which is a part of the frame work, and which lifts the inner circle out of its position when it is too close to the outer ring, and brings it down again when forced up. To secure it in this latter position there is also a screw to confine its action, and in the tube through which it works, and to regulate its velocity at the same time. Over the extinguisher-shaped cap we have named, is a sort of inverted seive or cylindrical hut, which is the upper covering, and between which and the cap is kept the grain to be reduced, and there its entrance between the rings is equalized.

Another part of the invention is to surround the metal wheels with *annula*, or circular trenches of cold water, keeping the metal cool, and preventing the corrosion of the wheels, and combustion of the grain. This must be a necessary adjunct to every mill whereof the grinding parts are of metal, and although the idea is originally ingenious, the application is manifestly of extreme simplicity. A constant supply of water, and a constant drainage, as it becomes heated, are all that is required. Now as to the power by which this mill is to be wrought, a drawing accompanies the specification, not only of each of the rings, and of a section of the chief parts at work, but of the whole machine. In this the power is by a winch and fly wheel, with the means of adding any supplemental gear to increase velocity. A man's hand is the power, and a crank turning the spindle we have described, causes a partial revolution of the inner ring, and the revolution can be made complete if necessary. Although perfect rotation is not so suited to the invention as a vacillatory or alternate motion, the supposed advantages of this invention are the saving of expense, strength, and economy of space. The application of water is claimed as new, the toothed rings are claimed as new, and there is added a diagram to show that any number of rings may be made to act in the manner of the two described, by which the whole mill would be a series of concentric circles, acting on each other, fed in the same manner, watered also for coolness, and moved with almost the same power.

As a malt mill it appears exceedingly well adapted, and it might be made small enough for a coffee mill, or a pepper mill. To these latter uses we have seen a very similar principle applied.

[*Rep. Pat. Inv.*

Patent granted to ABRAHAM ADOLPHE MOSER, *Engineer, for improvements in certain descriptions of Fire Arms. Dated December* 15, 1831.

This new way of firing muskets, fowling pieces, and pistols, requires a very different mode of loading, and a different sort of lock from those in use at present. The object is to ignite the powder at once by a flame of considerable size within the chamber, and without the narrow passage, or touch hole, which is easily stopped up, and gives out a small line of flame to the powder instead of a broad sheet as it ought to give. No priming, therefore, no percussion caps, are used by Mr. Moser.

His next object is to save time, and prevent the necessity of ramming down the cartridge. It is possible, nay necessary, according to his plan, to make the cartridge so much less in diameter than the calibre of the barrel, as to allow it to run home instantly, by merely dropping it into the muzzle; and to keep it in its place till fired, and give it the force it gains from confinement, a small pin or plug dependent on the trigger guard, contracts the space of the barrel to that of the cartridge by a single motion, and keeps it in its position till the trigger being pulled allows of its escape.

Now the mode of combustion is by a small pellet of detonating mercury secured to a common piece of card wadding, and forming the inner end of the cartridge. This by way of priming. Instead of flint and steel, there is a long pin, secured within a sheath, and moving through the powder chamber by means of strong springs. When the gun is loaded, and the cartridge secured, this pin is quiescent in its sheath; but when the trigger is pulled, the springs expand and force the pin beyond its sheath, to the detonating pellet on which it acts, causing explosion, and creating a sheet of flame within the chamber which is exposed to the powder, ignition takes place, and the gun goes off, the finger is removed from the trigger, the springs recoil, and the pin returns to its sheath till another cartridge is introduced, and it becomes necessary to repeat the action.

The lock is very ingenious, but it is very difficult, perhaps impossible to be described accurately without a marked drawing; the principle, however, is such as we have stated it.

The means of producing the effect by the aid of the pin and the springs, can be very readily conceived, but we confess that the arrangement of the parts is not clear to us after the most careful study of the specification, and we will not attempt to explain what we cannot comprehend. The plug, or stop, by which the cartridge is retained, appears to us a dangerous expedient, and the trigger guard as figured in the drawings is awkward. Neither is the ram-rod dispensed with, though not used in loading the piece.

[*Rep. Pat. Inv.*

Notice respecting the production of Electric, or Magnetic Sparks, from the common Magnet.

"Palmam qui meruit ferat," has always been a favourite motto of ours, and whilst we are ready to award the highest praise to Mr. Faraday for his assiduous, indefatigable, philosopher-like pursuit of the subtle principle and peculiarity of electricity, and of his proofs of the affinity (or identity?) between it and magnetism; and whilst we are equally prompt to bestow our meed of approbation on Dr. Ritchie, for his advancement of the same object, we must offer the palm of perfect success to Mr. Saxton, an ingenious native of Philadelphia, now residing in London, as the original demonstrator of the capability of eliciting a spark from the common magnet. To do this, we must first refer to the Minutes of the Royal Institution.

On the 11th of May, Dr. Ritchie, Professor of Natural Philosophy, stated to the Institution, that he had followed in the track of Mr. Faraday, in his late brilliant discoveries, and was happy to say that he had uniformly arrived at the same conclusions. He had also succeeded in making the spark, which had been obtained by Mr. Faraday in breaking the magneto-electric circle, visible to a large assembly. This was done by placing an explosive mixture of oxygen and hydrogen in the course of the spark, which immediately produced a loud report and a flash of light. He employed a horse-shoe magnet, between the ends of which were placed a couple of tubes; a wire was introduced into each, and their connexion maintained by a conducting medium. The wires were connected to the magnet by the folds of copper riband. The gas was introduced by a bladder and stop-cock; the contact suddenly broken; and the spark made evident by an explosion. Dr. Ritchie declared his belief that no such spark could be elicited from any but a *temporary* magnet.

At this time Mr. Faraday came forward and stated that he had succeeded in obtaining a spark from a *natural* magnet. Mr. Faraday had borrowed Brown's magnet from the academy at Woolwich. A small bar of iron, about six inches long, was used in contact with the extremities of the magnet. Two connecting wires were taken from each end of this small bar, and being bent at right angles, overlapped each other. The undermost terminated in a disc, about the size of half a crown. By a rapid percussion of the bar against the magnet, the disc and wire broke, in contact, by their electricity, and a beautiful bluish spark was produced.

Now, dates are very important to the identification of a discovery, and it is upon these, and upon concurrent testimony, that we rely in support of our conceding to Mr. Saxton the merit of the earliest demonstration of these interesting phenomena in England. It was on the second day of May, that Mr. Saxton first produced an electric (?) spark from a common magnet of very great power, which he was then constructing for exhibition at the New Gallery, in Adelaide street, Strand; and on that, or the following day, the experiment was repeat-

ed in the presence of Dr. Ritchie, who declared it to be the only one he had witnessed. After some trifling improvements had been made by Mr. Saxton, in the apparatus used for breaking the continuity of the subtle fluid, he succeeded in causing the explosion of gunpowder, a much less inflammable material than that used by Dr. Ritchie, from ignition by the spark, which we have, since then, seen him repeatedly perform. Does Dr. Ritchie call Mr. Saxton's magnet one of the *temporary?*

We subjoin a description of the magnet constructed by Mr. Saxton. It is called a horse-shoe magnet, (very elongated,) and is formed of eight shear steel plates, twenty-eight inches in length from the poles to the centre edge, three inches wide, and forming together a thickness of two inches and a half; at the greatest width of the curvature it measures nine inches, and at the poles seven inches across; the poles have a return inwards, towards each other, and are there separated by a space of one inch and a half. The keeper, or lifter, which is made of the purest soft iron, is four inches long, one inch and a quarter wide, and one thick. Around the middle of the keeper, and occupying with its lower section the space between the poles, is a wooden winder, having about one hundred yards of common bonnet wire, threaded, from which the two ends, composed of four lengths of the wire, twisted together, are carried out, with a vertical curve of about three-fourths of a circle, one of these twisted ends passing beyond each end of the keeper, and resting upon the respective poles of the magnet. A small wooden lever is so fixed to the winder and keeper as to admit of the whole being suddenly forced up from the magnet by a smart stroke; and a very beautiful and brilliant spark is invariably elicited, at whichever end of the wire is first separated from the magnet.

It is Mr. Saxton's intention to add several plates to his magnet, and to ascertain, by a series of experiments, the best size for the keeper—the best description of wire to be used—the easiest mode of causing an instantaneous separation of the wire from the magnet, and other interesting consequences, the result of which we shall take occasion to communicate to our readers. [*Lond. Paper.*

On the utility of fixing Lightning Conductors in Ships.

[Continued from p. 205.]

12. Although the application of lightning conductors to buildings on shore is always judicious, and their advantages very apparent, yet on ship board, where the effects of lightning are most to be dreaded, the introduction of this means of defence has been slow and imperfect. The conductor hitherto employed at sea consists of long flexible chains, or links, of metal, about the size of a goose quill, sometimes of iron: those employed in H. M. Navy, however, are of copper; they are usually packed in a box, and are intended to be set up from the mast head to the sea when occasions require, so that, as

observed by Mr. Singer in his excellent work on electricity, partly from inattention, and partly from prejudice, they frequently remain in the ship's hold during long and hazardous voyages quite unemployed; a remark, the truth of which is but too frequently verified in the damage so constantly happening at sea during lightning storms.*

13. The necessity of providing the best possible security against the effects of lightning on ship board has been long admitted, but continuous and fixed metallic rods have been deemed inapplicable to ships, in consequence of their masts, the only parts to which they can be attached, being exposed to chances of injury, to motion in a variety of ways, to frequent elongation and contraction, and to the necessity which frequently arises for removing the higher masts altogether, and placing them on deck. It was probably from these causes that the small flexible chains, or links, above mentioned, were employed. Such conductors, however, will probably, on examination, be found less applicable than fixed continuous lines of metal, and, in every point of view, inefficient substitutes for them. Their great want of continuity, as well as their want of mass and surface, is very unfavourable to the transmission of severe explosions, the electric matter becoming sensible at the points of juncture, as is evident by the sparks which appear upon them at the time of the discharge, so that in some instances they have been actually disunited: they are likewise objectionable as being liable to every species of injury incident to a ship's rigging, and much difficulty is experienced in keeping them in their position, and unbroken, more especially during gales of wind, and at night, when the ship is under sail, and when it is perhaps required, as is already observed, to remove some portion of the higher masts. It has therefore been long considered desirable to apply, if possible, a permanent conductor, which should be always in its place, and ready for action; and various attempts have been made, and suggestions advanced, at different times, to apply fixed lightning conductors in ships, as the subject from time to time has demanded further consideration.

To protect a ship effectually from damage by lightning, it is essential that the conductor be as continuous and as direct as possible, from the highest points to the sea—that it be permanently fixed in the masts, throughout their whole extent, so as to admit of the motion of one portion of the mast upon another; and, in case of the removal of any part of the mast, together with the conductor attached to it, either from accident or design, the remaining portion should still be perfect, and equivalent to transmit an electrical discharge into the sea.

15. To fulfil these conditions, pieces of sheet copper, from one-eighth to one-sixteenth of an inch thick, and about two feet long, and varying from six inches to one inch and a half in breadth, may be in-

* Case (*f.*) p. 204. The conducting chain, at the time of the first explosion, was stowed away in its box below, although set up in time to prevent the effects of the second explosion. A minute account of this will be found on referring to vol. iv. (old series) p. 197, and vol. ii. (new series) p. 63.

serted into the masts in two laminæ, one over the other; the butts, or joints, of the one being covered by the central portions of the other. The laminæ should be rivetted together at the butts, so as to form a long, elastic, continuous line; the whole conductor is inserted under the edges of a neat groove, ploughed longitudinally in the aft side of the different masts, and secured in its position by wrought copper nails, so as to present a fair surface. The metallic line thus constructed, will then pass downward from the copper spindle at the mast head, along the aft sides of the royal mast and top-gallant mast, being connected in its course with the copper about the sheeve holes. A copper lining in the aft side of the cap, through which the top-mast slides, now takes up the connexion, and continues it over the cap, to the aft side of the top-mast, and so on, as before, to the step of the mast. Here it meets a thick, wide, copper lining, turned round the step under the heel of the mast, and resting on a similar layer of copper, fixed to the keelson. This last is connected with some of the keelson bolts, and with three perpendicular bolts of copper, of two inches diameter, which are driven into the main keel upon three transverse, or horizontal, bolts, brought into immediate contact with the copper expanded over the bottom. The laminæ of copper are turned over the respective mast heads, and secured about an inch or more down on the opposite side; the cap which corresponds is prepared in a similar way, the copper being continued from the lining in the aft part of the round hole, over the cap into the fore part of the square one, where it is turned down and secured as before, so that when the cap is in its place, the contact is complete. In this way, we have, under all circumstances, a continuous metallic line, from the highest points to the sea, which will transmit the electric matter directly through the keel,* being the line of least resistance.

16. From what has been already observed, it will be apparent, that, in whatever position we suppose the sliding masts to be placed, whether in a state of elongation or contraction, still the line of conduction will remain perfect, for that part of the conductor which necessarily remains below the cap and top, when the sliding masts are struck, is no longer in the line of action, consequently its influence need not be considered.

17. The following table exhibits the mean proportion of a conductor thus constructed on one mast of a fifty gun frigate, as compared with the copper links usually furnished to the British navy, together with the necessary equivalent in copper or iron bolt, in order to obtain a conductor of the same mass.

The resulting quantities in the last line at the bottom of the table, represent, with the exception of the proposed conductors, the masses, surfaces, and diameters, of cylindrical metallic rods, supposed to extend the whole length of the mast. Thus in column 2, we have

* Since the mizen-mast does not step on the keelson, it will be necessary to have a metallic communication at the step of the mast with the perpendicular stancheon immediately under it, and so on to the keelson, as before, or else to carry the conductor out at the sides of the vessel.

the diameter and surface of a copper rod, containing 2423 cubic inches of metal, being an equal quantity of matter to that in the proposed conductors, and from which it is calculated. The sums, therefore, are not the result of the addition of the successive masts. The same may be observed in column 3; taking the equivalent in iron. In the third and fourth columns, we have the mass and surface of a copper rod of half an inch in diameter, generally allowed to be adequate to any shock of lightning yet experienced: and, lastly, in column 4, we have the mass and surface in the conductors now furnished to the British navy; which we find, as compared with the mass in the proposed arrangement, is only as 94.4 : 2423.

Table.

Succession of Masts.	Proposed conductors.		Equivalent in a copper rod.		Equivalent in an iron rod; taking conducting powers only as 4 to 1.			Mass and surface in a copper rod of 1-2 in. diam.		Mass and surface in present conductors.	
	Mass.	Surface.	Diamet'r.	Surface.	Mass.	Surface.	Diamet'r.	Mass.	Surface.	Mass.	Surface.
	cubic in.	sq. in.	in.	sq. in.	cubic in.	sq. in.	in.	cubic in.	sq. in.	cubic in.	sq. in.
Royal Pole. Conductor 18 ft. 3 in. long, 2 in. wide; two laminæ, each 1-16th of an inch thick.	54	1752	.56	385	216	770	1.12	42	343	10.5	171
Top-gallant mast. Conductor 17 ft. long, 2½ in. wide; two laminæ, one 1-8th of an inch thick, the other 1-16th.	95	2040	.77	493	380	986	1.54	40	320	10	160
Topmast. Conductor 50 ft. long; copper 4 in. wide; two laminæ, each 1-8th of an inch thick.	600	9600	1.1	2070	2400	4140	2.2	117	942	19.2	471
Lower-mast. Conductor 93 ft. long; copper 6 in. wide; two laminæ, each 1-8th of an inch thick.	1674	26784	1.38	4837	6696	9675	2.76	219	1753	54.7	876
	2423	40176	1.2	8064	9692	16128	2.4	418	3358	94.4	1678

18. The manner in which the conductors here proposed, are applied to the mast, gives to the whole the form of a flattened, conical surface,—wide at the base, and diminishing gradually to a point.

It has been stated by one of the most eminent of the French philosophers, that this form is the best possible for a lightning rod.

19. The objections made to fixing lightning conductors in ships, are, for the most part, such as have been urged against lightning rods generally, and are principally as follows:—It is said that by fixing continuous lines of metal in the mast, we *invite* an electrical discharge from the atmosphere, and that by means of an attractive power, which, it is assumed, the metal is possessed of, the explosion is drawn exclusively upon the vessel; that, inasmuch as we can never ascertain the absolute quantity of electric matter which may be discharged from a thunder cloud, it is possible that the transmitting power of any conductors we can apply, may be inadequate to the end in view, so that they may possibly become fused; and hence it is inferred that much damage may be the consequence:—That in fixing lightning conductors in the masts, we can only have *surface*, whereas, the properties of a conductor depend on the *mass*, and not on the *surface* of the metal: hence the metallic surface is calculated to do considerable mischief, by conducting the lightning into the body of the vessel. Such are the principal objections to this application, and which, it is hoped, are fairly stated. They are well deserving serious consideration, but they will be found, on examination, to be inconsistent with experience, and with the known laws of electrical action. We shall, however, by a candid enquiry, give these objections all the attention which their connexion with so important a question demands.

20. The notion that a lightning rod is a positive evil, will be found to have arisen out of the fact already mentioned, (8) namely, that lightning invariably passes through the line, or lines, of least resistance between the points of action; hence it seizes on all those substances which oppose the least resistance to its passage; metallic vanes, vane spindles, iron bars, knives, and pointed metallic bodies, generally, will therefore be very commonly found in the course of the explosion; and from this circumstance, they have been considered to exert an attractive force upon the matter of lightning, so as to draw it aside from its destined course to the destruction of the substances in connexion with them.

21. It will be found, however, that the action of pointed metallic bodies is purely passive; that they only afford, by the aptness of their parts, an easy transmission to the electric matter; so that they can no more be said to attract the matter of lightning, than a dike can be said to attract the water which necessarily flows through it at the time of heavy rain; and, as in the one case, the water is drawn down by a force not peculiarly appertaining to the dike, so, in the other case, the electric matter is determined to a given point, in a somewhat similar way, by a force not appertaining to the metal. More-

over, it may still further be reasoned by analogy, that, as the quantity of water transmitted will depend on the capacity of the dike, and the final protection it gives in conveying the fluid, on the length to which it is continued, so, on the other hand, the protection afforded by a lightning rod will also depend on *its* capacity, and the distance to which it runs. If, in both cases, the length be extended until the force in action be satisfied, the protection received will be as the capacity for transmitting the current: if both be perfect, the protection will be complete; if the dike be not present, the water must be supposed to run loose and undirected; or, if its continuity be frequently interrupted, or narrowed to a small compass, the damage must then be supposed to happen in the intermediate spaces. Such is, in fact, the way in which all bodies of the conducting class already mentioned, (4,) operate in conveying electrical discharges; and it must never be forgotten as an important feature in this discussion, that, whenever we erect an artificial elevation on the earth's surface in the ordinary way, we do in fact, set up a conductor of electricity, upon which the electricity of the atmosphere will fall, and no human power can prevent it. Hence, if metallic bodies be present, those will be first assailed; if not, then the electric matter will fall on the bodies next in conducting power, and so on.

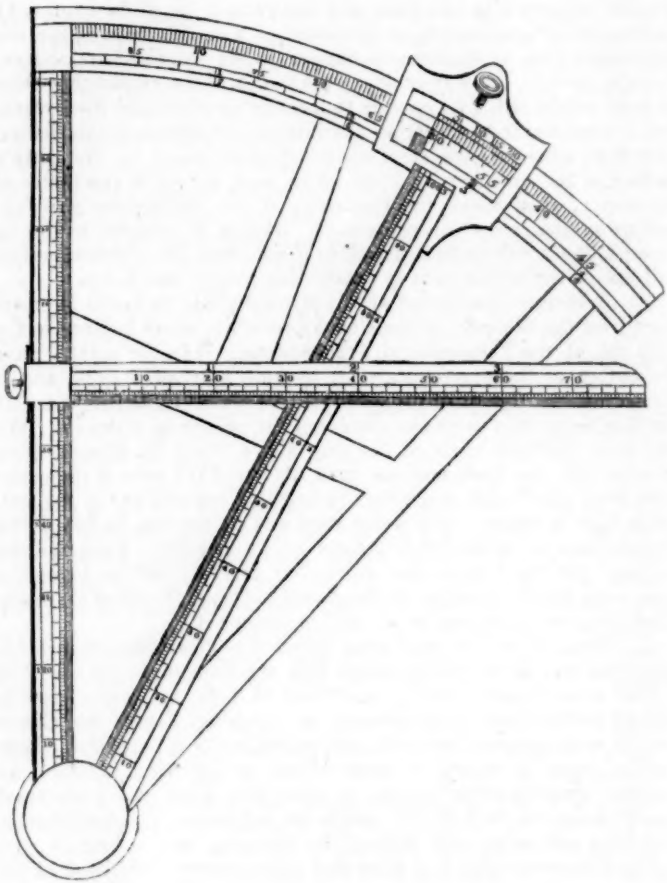
22. A curious illustration of this principle, will be found in an extract from the Memoirs of the Count de Forbin, which is given in the 48th vol. of the Philosophical Transactions. "In the night," says the author of these memoirs, "it became extremely dark, and it thundered and lightened dreadfully. As we were threatened with the ship being torn to pieces, I ordered the sails to be taken in. We saw upon different parts of the ship above thirty St. Elmo's fires; amongst the rest there was one upon the top of the vane of the mainmast more than a foot and a half in height; I ordered one of the sailors to take it down. When this man was on the top, he heard this fire; its noise resembled that of fired wet gunpowder. I ordered him to lower the vane and come down, but scarcely had he taken the vane from its place, *when the fire fixed itself upon the top of the mainmast*, from which it was impossible to remove it."

23. Since, then, the conducting power of bodies differs only in degree, and that the action by which they are assailed, is the result of a great natural agent quite independent of them, we may expect to find all bodies liable to be assailed by lightning, though the effects may be most apparent when the conducting power is imperfect. Thus we find cases on record, of ships struck by lightning, in which no metallic spindles were present, or other iron work about the mast head;* moreover, it is by no means an uncommon circumstance to find trees and rocks rent asunder by lightning, and to hear of men and quadrupeds, even in a plain and open country, destroyed at the

* See Philosophical Transactions, vols. xlix. and lxix., damage done to the sheer hulk at Plymouth, and on board the Atlas, East Indiaman.

time of a thunder storm, when the electric matter strikes the earth's surface. [*Rep. Pat. Inv.*

Crow's Seaman's Octant and Traverse Worker.



The land surveyor has his sliding rule; why should not the navigator also have his instrumental calculator? Mr. Crow, late of

Gravesend, now of London, has furnished an admirable answer to this question, in the octant and traverse worker, shown on the last page. The construction of the instrument is so simple, and its utility so very obvious, that we wonder something of the kind has not been invented before. Seamen work their reckoning at present with the help of printed tables of sines, tangents, &c., which are calculated on the principle, that the sine, tangent, and secant of every angle correspond with the sine, tangent, and secant of the circle which measures that angle, and that the sides of the angle are in the same proportion, one to another, as the sines of the opposite angles. Mr. Crow's octant does this work for them mechanically, and with an accuracy to which no pen and ink, or printed calculations, can possibly pretend. The instrument is of a triangular form, each of the three sides representing the sine, tangent, and secant of the opposite angle. The arc is graduated to 45 degrees, which are subdivided by a vernier into minutes; in the ordinary traverse tables, degrees only are given. The following additional explanations we extract from a small descriptive treatise by Mr. Crow, which accompanies the octant:—

"There is a double row of figures to the degrees, to denote angles and their complements in either case; that is, when the angle is less than 45 degrees, the lower row become the complement of the given angle, and the contrary—only that the minutes found on the vernier are to be subtracted from 20′, and the difference added to the complement will be the degrees and minutes greater than forty-five degrees. When the given angle is less than forty-five degrees, the index is to be placed over it on the arch, in the usual way. Observe always to count from left to right when the angle is less than forty-five degrees, and from right to left when it is more than forty-five degrees. The same observation applies to the scale of rhumbs or points, which are immediately below; for if the course be three points, it shows at once its complement, five points underneath; and if five points be the given course, then the difference of latitude is found on the slide, and departure on the divided limb. Now for the three sides of the triangle—

"First. The diff. of lat. is on that side upon which the slide traverses; and it is also called the divided limb. Here the diff. of lat. is always to be found or laid off, if the course is not more than four points, or forty-five degrees.

"Second. The dep. is the slide, and traverses up and down; upon which the dep. is always to be found or set off, when the course is not more than four points, or forty-five degrees.

"Third. The distance or index. On this side of the triangle the dist. is to be found in the angle of intersection with the slide.

"With respect to the diff. of lat. and dep. one general rule must invariably be observed—it is this: That when the given course is more than four points or forty-five degrees, these sides change names; and so they always do when the diff. of lat. is less than the dep. For if it be a five point course, the diff. of lat. is then to be found on the

slide, and dep. on the limb; and the same is to be observed when the diff. of lat. is less than the dep.; that is, set off the diff. of lat. on the slide, and the dep. on the limb, when these are given to find course and dist.; and the angle of the course thus produced will be found on the arch, and must be read off from right to left, as it will be more than forty-five degrees.*

"Fourth. To find or set off any required number on the sides of the triangle on the common scale, No. 10 to 100 on the limb and index, and to 75 on the slide. Required that the slide should be placed to 53.2 on the diff. of lat. or limb. First, find 53; then take the first subdivision next to this last, is $\frac{2}{10}$; to this place the edge of the slide, and you will then have on the diff. of lat. side 53.2, the number required. But this number may be called 53.20, thus bringing out the result to two decimal figures, which is equal in accuracy to the table of logarithms, only with this great advantage, that the results are had by the instrument tenfold easier and quicker. The same numbers may also be counted 532. Now the large scale is numbered 1 to 5 on the two longest sides, and 1 to 3 on the slide. This scale is convenient when working for the meridianal diff. of lat. as it frequently happens to run up to thousands. If short boards are made, as two to six miles, which often happens in light airs and calms, any distance is readily set off, and the corresponding results expeditiously obtained. Now to suit our convenience, we may assume the first 10 on either of the sides, on the common scale, as one or unity, and 20 above, as 2, 30 as 3, &c.; then will the first division, which is cut up to the second line, be $\frac{1}{10}$, and the longer division $\frac{2}{10}$, &c. &c. In like manner may the first 1 on the large scale be assumed as 10, 2 as 20, 3 as 30, &c.; then will all the longer divisions from 1 to 2, be each 1, or unity, and the subdivisions between these will each become $\frac{1}{10}$. Also may the 1 on the large scale stand for 100, 2 for 200, &c.; the subdivisions then are 1 each. Now admit the distance run to be six miles on a S. W. by S. or three-point course—place the chamfered edge of the index to 3 on the arch, then bring the slide to cut 60, which now stands for six miles, the dist. run, and it is done. On the limb is 5′ for diff. of lat., and on the slide is 3′.3, or a little more, for the dep."

The treatise from which we have made the preceding extract, contains also numerous examples of the mode of calculating by means of the instrument; and these are so distinct and clear, that he must be a dull sailor indeed, who after reading and working them, should find himself at a loss to resolve, by means of the octant, any case whatever in practical navigation.

We should think it a matter of regret, were this instrument to supersede altogether what Jack calls head-work; but, we apprehend, it is quite as likely to lead him to the sufficient reason, in most cases, as the means he at present employs. Of books, there is a mechani-

* To work and read off by this instrument, it is intended that the heel, or angular point, should be towards the body.

cal use, as well as there is of instruments. To what Mr. Crow says on this head, every inquisitive landsman who has traversed the deep sea, can bear witness.

"How few among that useful class of men, plain practical sailors, are able to go to any extent into the basis of the science of navigation, and who continually are working their various problems without ever thinking further than that they are to add together certain numbers, and subtract others; and that if they do this right, they at last arrive at the desired result! This instrument will insensibly impress upon the minds of those who use it, that in every triangle all the parts bear a rigid and definite relation to each other, and that having certain things given, certain others can thence invariably be found; and that any three things that can be brought to the shape of a triangle, become, thereby, objects of simple computation, whether they are distance, difference of latitude and departure, or the mainmast, a main shroud, and the horizontal line joining that mast and shroud along the deck."

Besides, as the results produced by this instrument must necessarily be perfectly correct, it furnishes an excellent means of verifying computations, and must, on this account alone, be of great use to the young and inexperienced.

We earnestly hope that Mr. Crow will not go without the reward which he deserves for this valuable contribution to nautical practice. He acknowledges to have received "liberal support and approval from the Hon. East India Company;" but speaks of the introduction of the instrument into the Royal Navy, as "a hope yet to be indulged." How is this? To whom can the improvement of navigation be of more importance than to the government of this, the first maritime nation in the world? Thousands and tens of thousands have been lavished by it on inventions, (Rotch's fid, for example) of not a tenth part the importance. [*Mech. Mag.*

¶ *Selections from Professor Babbage's Work "on the Economy of Machinery and Manufactures."*

Lace made by Caterpillars.

A most extraordinary species of manufacture, which is, in a slight degree, connected with copying, has been contrived by an officer of engineers, residing at Munich. It consists of lace, and veils, with open patterns in them, made entirely by caterpillars. The following is the mode of proceeding adopted:—

Having made a paste of the leaves of the plant, on which the species of caterpillar he employs feeds, he spreads it thinly across a stone, or other flat substance, of the required size. He then with a camel's hair pencil, dipped in olive oil, draws the pattern he wishes the insects to leave open. This stone is then placed in an inclined position, and a considerable number of the caterpillars are placed at

the bottom. A peculiar species is chosen, which spins a strong web; and the animals commence at the bottom, eating and spinning their way up to the top, carefully avoiding every part touched by the oil, but devouring every other part of the paste. The extreme lightness of these veils, combined with some strength, is truly surprising. One of them measuring twenty-six and a half inches by seventeen inches, weighed only 1.51 grains, a degree of lightness which will appear more strongly by contrast with other fabrics. One square yard of the substance of which these veils are made weighs four grains and one-third, whilst one square yard of silk gauze weighs one hundred and thirty-seven grains, and one square yard of the finest patent net weighs two hundred and sixty-two grains and a half.

Convenient method of Gauging.

The time and labour consumed in gauging casks partly filled, has led to an improvement which, by the simplest means, obviates a considerable inconvenience, and enables any person to read off, on a scale, the number of gallons contained in any vessel as readily as he does the degrees of heat indicated by his thermometer. A small stop-cock is inserted near the bottom of the cask, which it connects with a glass tube of narrow bore fixed to a scale on the side of the cask, and rising a little above its top. The plug of the cock must be turned into three positions: in the first it cuts off all communication with the cask: in the second, it opens a communication between the cask and the glass tube: and in the third, it cuts off the connexion between the cask and the tube, and opens a communication between the tube and any vessel held beneath the cock to receive its contents. The scale of the tube is graduated by opening the communication between the cask and the tube, and pouring into the cask a gallon of water. A line is then drawn on the scale opposite the place in the tube to which the water rises. The operation is repeated, and at each successive gallon a new line is drawn. Thus the scale being formed by actual measurement,* both the proprietor and the excise officer see, on inspection, the contents of each cask, and the tedious process of gauging is altogether dispensed with. Other advantages accrue from this simple contrivance in the great economy of time which it introduces in making mixtures of different spirits, in taking stock, and in receiving spirits from the distiller.

Diamonds for Cutting Glass.

The art of using the diamond for cutting glass has undergone, within a few years, a very important improvement. A glazier's appren-

* This contrivance is due to Mr. Henneky, of High Holborn, in whose establishment it is in constant employment.

tice, when using a diamond set in a conical ferule, as was always the practice about twenty years ago, found great difficulty in acquiring the art of using it with certainty, and at the end of a seven years apprenticeship, many were found but indifferently skilled in its employment. This arose from the difficulty of finding the precise angle at which the diamond cuts, and of guiding it along the glass at the proper inclination when that angle is found. Almost the whole of the time consumed, and of the glass destroyed in acquiring the art of cutting glass, may now be saved by the use of an improved tool. The gem is set in a small piece of squared brass, with its edge nearly parallel to one side of the square. A person skilled in its use now files away one side of the brass, until, by trial, he finds that the diamond will make a clean cut, when guided by keeping this edge pressed against a ruler. The diamond and its mounting are now attached to a stick similar to a pencil, by means of a swivel, allowing a small angular motion. Thus the merest tyro at once applies the cutting edge at the proper angle, by pressing the side of the brass against a ruler; and even though the part he holds in his hand should deviate a little from the required angle, it communicates no irregularity to the position of the diamond, which rarely fails to do its office when thus employed.

The relative hardness of the diamond, in different directions, is a singular fact. An experienced workman, on whose judgment I can rely, informed me that he had seen a diamond ground with diamond powder on a cast iron mill for three hours without its being at all worn, but that changing its direction with reference to the grinding surface, the same edge was ground down.

Example of the method of Calculating by Machinery.

As the possibility of performing arithmetical calculations by machinery may appear to non-mathematical readers to be rather too large a postulate, and as it is connected with the subject of the *division of labour*, I shall here endeavour in a few lines to give some slight perception of the manner in which this can be done, and thus remove a small portion of the veil which covers that apparent mystery.

That nearly all tables of numbers which follow any law, however complicated, may be formed, to a greater or less extent, solely by the proper arrangement of the successive addition and subtraction of numbers befitting each table, is a general principle, which can be demonstrated to those only who are well acquainted with mathematics; but the mind, even of the reader who is slightly acquainted with that science, will readily conceive that it is not impossible, by attending to the following examples. Let us consider the subjoined table. This table is the beginning of one in very extensive use, which has been printed and reprinted very frequently in many countries, and is called *a table of square numbers.*

Terms of the table.	A table of squares.	B first difference.	C second difference.
1	1		
		3	
2	4		2
		5	
3	9		2
		7	
4	16		2
		9	
5	25		2
		11	
6	36		
		13	
7	49		

Any number in the table, column A, may be obtained by multiplying the number which expresses the distance of that term from the commencement of the table by itself; thus 25 is the 5th term from the beginning of the table, and five multiplied by itself, or by five, is equal to 25. Let us now subtract each term of this table from the next succeeding term, and place the results in another column, (B,) which may be called first difference column. If we again subtract each term from this first difference from the succeeding term, we find the result is always the number two, (column C;) and that the same number will always recur in that column, which may be called the second difference, will appear to any person who takes the trouble to carry on the table a few terms further. Now when once this is admitted as a known fact, it is quite clear that, provided the first term (1) of the table, the first term (3) of the first differences, and the first term (2) of the second or constant difference, are originally given, we can contrive the table of square numbers to any extent, merely by simple addition: for the series of first differences may be formed by repeatedly adding the constant difference 2 to (3) the first number, column B, and we then necessarily have the series of odd numbers, 3, 5, 7, &c.; and again, by successively adding each of these to the first number (1) of the table, we produce the square numbers.

Having thus, I hope, thrown some light upon the theoretical part of the question, I shall endeavour to show that the mechanical execution of such an engine as would produce this series of numbers, is not so far removed from that of ordinary machinery as might be conceived. Let the reader imagine three clocks, placed on a table side by side, each having only one hand, and each having a thousand divisions instead of twelve hours marked on the face, and every time a string is pulled let them strike on a bell the number of divisions to which the hands point. Let him further suppose that two of the clocks, for the sake of distinction called B and C, have some mechanism by which the clock C advances the hand of the clock B one division for each stroke it makes upon its own bell; and let the clock B, by a similar contrivance, advance the hand of the clock A one division for each stroke it makes upon its own bell. With such an ar-

rangement, having set the clock A to the division I, that of B to III, and that of C to II, let the reader imagine the repeating parts of the clocks to be set in motion continually in the following order: viz. pull the string of clock A; pull the string of clock B; pull the string of clock C.

Repetition of process.	Movements.	Clock A. — Hand set to I.	Clock B. — Hand set to III.	Clock C. — Hand set to II.
		Table.	1st. diff.	2nd. diff.
1	Pull A.	A strikes - 1		
	— B.	The hand is advanced (by B) 3 divisions.	B strikes - 3	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
2	Pull A.	A strikes - 4		
	— B.	The hand is advanced (by B) 5 divisions.	B strikes - 5	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
3	Pull A.	A strikes - 9		
	— B.	The hand is advanced (by B) 7 divisions.	B strikes - 7	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
4	Pull A.	A strikes - 16		
	— B.	The hand is advanced (by B) 9 divisions.	B strikes - 9	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
5	Pull A.	A strikes - 25		
	— B.	The hand is advanced (by B) 11 divisions.	B strikes - 11	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2
6	Pull A.	A strikes - 36		
	— B.	The hand is advanced (by B) 13 divisions.	B strikes - 13	
	— C.	- - -	The hand is advanced (by C) 2 divisions.	C strikes 2

If now only those divisions struck and pointed at by the clock C be attended to and written down, it will be found that they produce the series of the squares of the natural numbers.

Meteorological Observations for September, 1832.

Moon. Days		Therm.		Barometer.		Dew point	Wind.		Water fallen in rain.	State of the weather, and Remarks.
		Sun rise.	2 P. M.	Sun rise.	2 P. M.		Direction.	Force.		
				Inches.	Inches.				Inches.	
☽	1	56°	70°	29.84	29.84	49	NW.	Moderate.		Clear day.
	2	53	71	30.00	30.00	48	W.	do.		Clear day.
	3	52	70	.00	.00	60	S.	do.		Light clouds—rain.
	4	51	69	29.80	29.70	69	S. SW.	do.	.70	Rain—cloudy.
	5	50	67	.64	.70	52	NW. W.	Breeze.		Flying clouds—clear.
	6	48	69	.84	.84	52	W.	do.		Clear day.
	7	56	72	.80	.71	69	SW.	do.		Cloudy—clear.
	8	54	74	.90	.95	51	SW.	do.		Clear—flying clouds.
	9	50	72	.94	30.5	49	W.	do.		Clear day.
⊙	10	51	72	30.20	.30	57	N. S.	do.		Clear—flying clouds.
	11	50	69	.00	29.90	67	SE. S.	Blustering.	.25	Cloudy—rain—rain in n't.
	12	52	66	29.80	.84	54	W.	do.	.15	Clear day.
	13	46	61	30.10	.10	44	W.	Moderate.		Clear day.
	14	44	69	.10	.04	49	W.	do.		Clear—light clouds.
	15	54	72	.10	.00	58	W.	do.		Cloudy—clear.
	16	60	81	.00	.00	66	W.	do.	.1	Clear day—slight thunder [shower.
	17	64	79	.00	.00	70	N.	do.		Clear day.
☾	18	59	72	.00	.20	63	SW.	do.		Clear day.
	19	58	69	.00	.00	68	SW.	Calm.		Clear day.
	20	64	77	.14	.00	61	SE.	Breeze.		Fog—cloudy.
	21	64	74	29.93	29.93	61	E.	do.		Cloudy day.
	22	66	69	.70	.70	69	E.	do.		Drizzle—cloudy.
	23	52	62	.70	.70	56	S.	do.	.1	Clear—cloudy.
	24	46	62	.80	.80	48	NW.	do.		Cloudy day—rain in n't.
	25	54	63	30.00	29.90	55	SE.	do.		Clear day.
	26	43	63	29.70	.80	45	W.	Blustering.	.7	Cloudy—flying clouds.
	27	51	70	30.00	30.00	47	W.	Moderate.		Clear day.
⊗	28	62	72	29.96	29.90	59	W.	do.		Cloudy—flying clouds.
	29	62	69	.98	.96	61	SE.	do.		Cloudy—flying clouds.
	30	56	68	.83	.70	61	NNE. N.	do.		Cloudy day.
				.70	.70	61	SW.	do.		Cloudy day.
	Mean	55.30	70.20	29.92	29.91	56.9			1.19	

		Thermometer.	Barometer.
Maximum height during the month,		89. on 11th and 14th.	30.20 on 10th and 18th.
Minimum	do.	44. on 14th.	29.64 on 5th.
Mean	do.	63.08	29.92